START

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SUPPORTING DOCUMENT

1. Total Pages 117

2. Title	3. Number	4. Rev. No.
Safety Assessment For Task #7 of the 200 West Area Carbon Tetrachloride Expedited Response Action	WHC-SD-ER-HC-001	0

5. Key Words

Safety Assessment
Vacuum Extraction System 200 West Area

6. Author

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Name (Type or Print)

3/21/91
Signature

Restoration Safety Documentation
Organization/Charge Code 29320/E621E

7. Abstract

The attached document is the Safety Assessment for the Task #7 of the 200 West Area Carbon Tetrachloride Expedited Response Action

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SAFETY ASSESSMENT FOR TASK # 7

OF THE 200 WEST AREA CARBON TETRACHLORIDE

EXPEDITED RESPONSE ACTION

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TABLES

FIGURES

ATTACHMENTS

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1.0 INTRODUCTION/SUMMARY

1.1 Introduction

The Westinghouse Hanford Company (WHC) is preparing to perform a Vapor Vacuum Extraction (VVE) test as part of preliminary work for the 200 West Area Carbon Tetrachloride Expedited Response Action (ERA). The ERA was previously identified as an Interim Response Action (IRA). The U.S. Department of Energy (DOE) identified three IRA site projects to expedite completion during 1991. The 200 West Carbon Tetrachloride was chosen as one of the ERAs. This activity is identified as Task # 7 of the ERA. The purpose of this initial activity is to obtain information on the volume and types of contaminants that can be extracted from existing wells, on trends in concentration of contaminants extracted over time, and identifying the zone of influence using existing wells for gas extraction. This document records the results of the safety assessment for Task # 7. The purpose of the safety assessment is to determine the potential consequences of an inventory of material associated with a facility or activity exclusive of engineered features or administrative controls[1].

1.2 Description of Work

The VVE test will help to determine the adequacy of extracting Volatile Organic Compounds (VOC's) vapors with carbon tetrachloride (CCl_4) being the primary known contaminant. An existing well will be used to conduct the test. The information collected will help in providing sufficient data for estimating geological materials properties, acquire experience in operating extraction systems here at WHC and evaluating the effectiveness for application as an interim remedial action.

1.3 Assessment Summary

The assessment of the VVE test was performed to ascertain whether the operation can be conducted safely. The potential consequences of this remediation activity indicate that the toxicity of CCl_4 is the controlling hazard for an accident involving airborne releases. Based upon the consequence analysis, limiting the CCl_4 inventory absorbed in carbon canisters at the work site to not more than 1800 lbs (820 kgs) allows this activity to be classified as low hazard.

1.4 Summary Recommendations

The recommendations and controls identified are necessary to assure the bases of the boundary inventory release. The calculated results are conservative. The required controls include:

* The analyses disclosed that this operation would be classified as a low hazard if the inventory of CCl_4, released from the heat of a single fire, does not exceed 1800 lbs (820 kgs). An Operational Safety Limit is discussed in section 4.0 limiting the inventory of CCl_4.

The consequence analysis indicates that heat from a fire will regenerate the carbon and release CCl_4. This release may cause unacceptable receptor exposures that may exceed the Threshold Limit Value-Ceiling (TLV-C) limits at a distance of 490 ft (150 m). A more detailed discussion of these analyses are provided in Section 3.0.

The following would be prudent actions to minimize the consequences of a release of CCl_4 to the site, onsite, offsite individuals and environs:

* Providing barriers to protect the canisters being used in the test from high heat, i. e., > 1700° F (925° C) or assuring that the onsite individual located at the Plutonium Finishing Plant (PFP) can be notified within 10 minutes that a fire involving CCl_4 has occurred and to evacuate. An emergency response plan should be developed and in place at PFP for identifying response actions associated with a fire involving CCl_4.

* Monitor fittings and positive pressure points for leakage of CCl_4 in the VVE test system.

* Maintain work area free of materials that could become missiles during periods of high winds.

* Maintain test site and nearby surrounding area clear of vegetation and combustibles.

* Apprise the Hanford Fire Department and the Emergency Planning organizations of the potential hazards associated with this remediation activity.

* Even though plutonium and americium are not expected to be removed during the test, provide monitoring for radioactive contamination. In the event there is a CAM alarm indicating radioactive contamination shutdown the process. Concurrence for restart will be required from the Site Safety Officer or the Health Physics Technician.

* The explosivity monitor is calibrated such that detection of the chemical with the lowest Lower Explosive Limit (LEL) will be detected (of the contaminants that will be extracted, n-butyl alcohol is the chemical identified in this assessment with the lowest LEL).

2.0 WORK DESCRIPTION

2.1 Location of Test

Past liquid waste disposal practices at the U. S. Department of Energy, Richland Operations (DOE-RL) Hanford Site have included the discharge of actinide-bearing liquid waste, generated from chemical processes used to purify plutonium, directly to the ground via structures called cribs. Three cribs are located in the 200 West Area just south and east of the PFP. The 216-Z-9 Crib is located approximately 330 ft (100 m) east of the PFP exclusion area. The 216-Z-18 Crib is located approximately 670 ft (200 m) south of the

PFP exclusion area. The 216-Z-1A Crib is located approximately 80 ft (25 m) south of the exclusion area. These three cribs were the principal CCl_4 disposal sites in the 200 West Area.

The test will take place at the south end of the 216-Z-1A Crib. The specific well that will be used for the extraction test is 299-W18-171. Three additional wells, 299-W18-87, 299-W18-150, and 299-W18-167, also located at the south end of the crib, will be used as observation wells. The test well is located approximately 490 ft (150 m) south of the PFP exclusion area. The nearest public highway, 240, is 2.8 mi (4.5 km) due west.

2.2 Cribs and Well Description

This section provides a description of the crib and well where the test will occur. Figures 1 and 2 are included to provide a basic site orientation. Also included in this section is a description of the other cribs that were contributors to the inventory of contaminants (primarily CCl_4) to the soil and groundwater.

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Figure I

HANFORD SITE AND 200 WEST AREA ORIENTATION

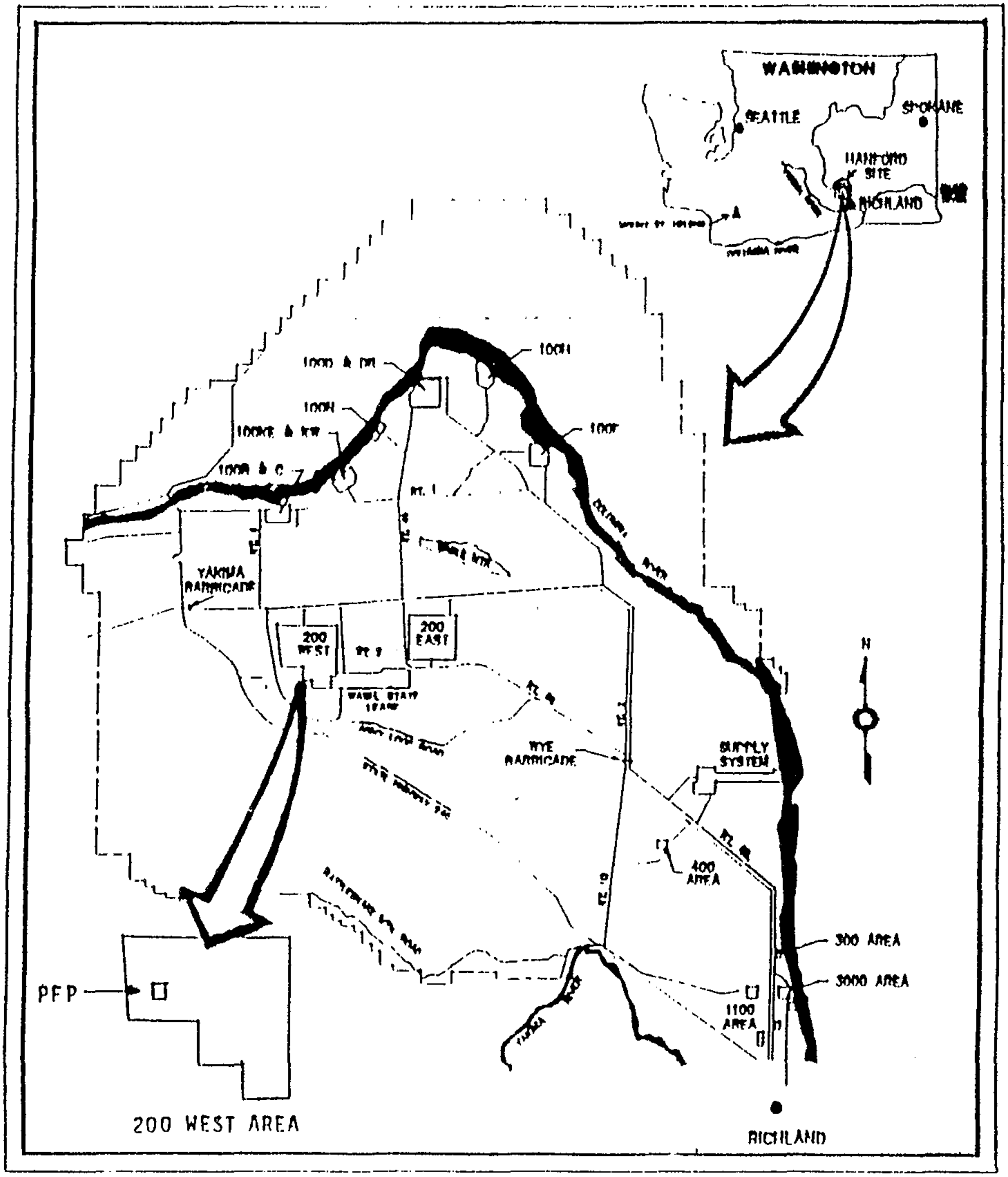
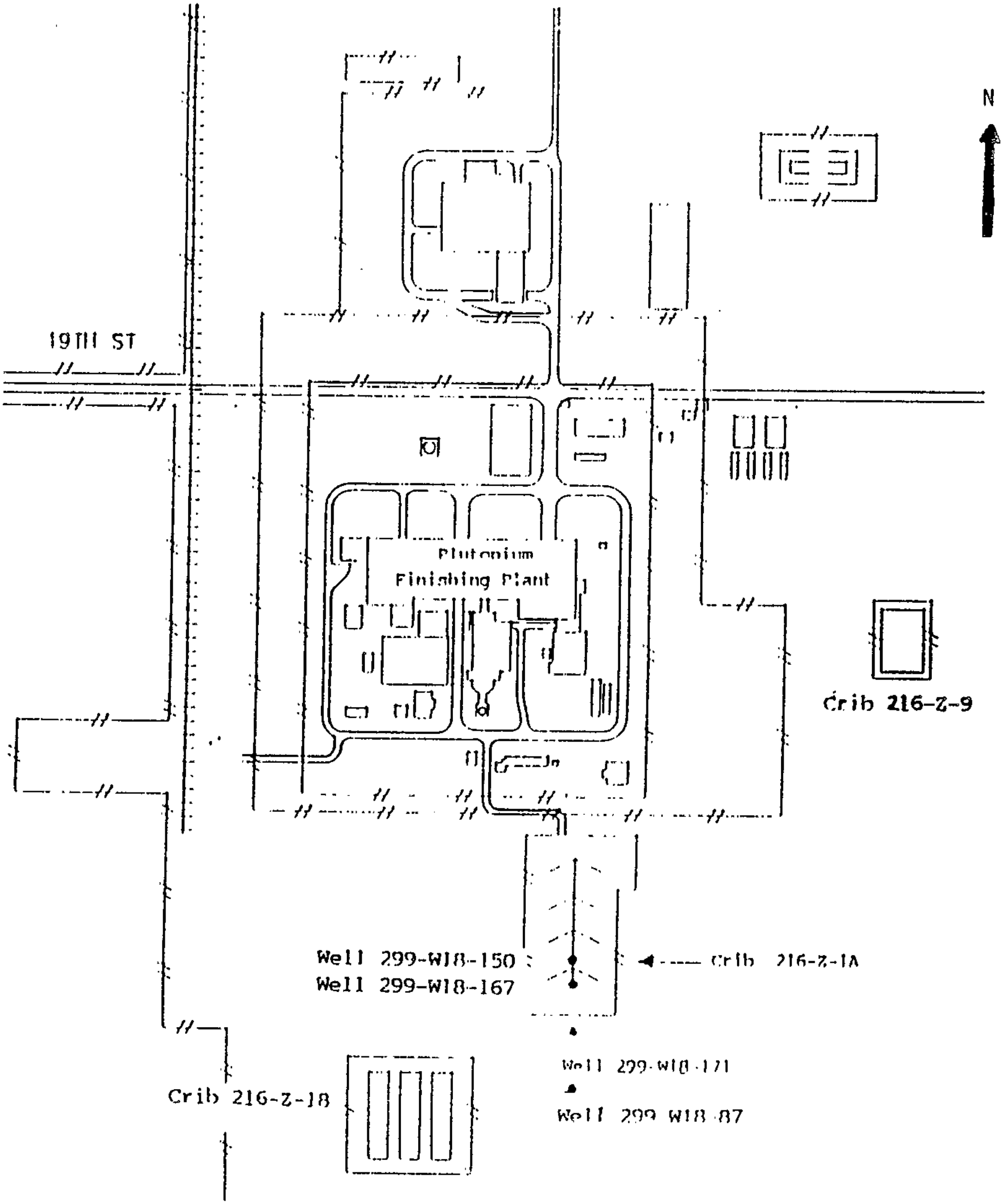


Figure 2

LOCATION OF WELL 299-W18-171



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The 216-Z-1A Crib has a rectangular excavation having a surface area approximately 200-by-360 ft (60-by-110 m). The side walls of the 20 ft (6 m) deep excavation were sloped inward, resulting in a floor dimension for the facility of approximately 115-by-275 ft (35-by-84 m). The floor of the excavation was covered by a 4 ft (1.2 m) thick cobble layer with a minimum north-to-south surface slope of 1%.

A herringbone pattern of 8 in. (20 cm) diameter clay pipe, comprised of a 260 ft (80 m) long central distributor pipe and seven pairs of 70 ft (20 m) laterals, was placed on the cobble layer. The 100-by-260 ft (30-by-80 m) rectangular area covered by the piping system was then overlain with 0.5 ft (0.15 m) of cobbles and 5 ft (1.5 m) of sand and gravel. The crib was used to receive approximately 5.2E+06 L of aqueous and organic waste from the PFP Plutonium Reclamation Facility and the 242-Z Waste Treatment/Americium Recovery Operations from 1964 to 1969. The crib also was used between 1949 and 1959 to receive the overflow of waste from three other cribs. The crib received approximately 245 metric tons of CCl_4.

The test well was drilled in 1977, along with other wells to collect sediment samples for determining the configuration of the waste plume beneath the 216-Z-1A Crib. The well was drilled to a depth (bottom of borehole) of about 135 ft (40 m) using 0.5 in. (1.3 cm) carbon steel casing with an 8 in. (20 cm) inside diameter. The well is located approximately 30 ft (10 m) from the south side of the 216-Z-1A Crib. A description of the well is provided in Attachment 1.

The 216-Z-9 Crib is a 60-by-30 ft (18-by-9 m) excavation, 20 ft (6.5 m) deep. The surface is a 120-by-90-by-0.75-ft (37-by-27-by-.23 m) thick concrete trench cover at ground level. Two 1.5-in. (3.5 cm) stainless steel pipes discharged liquid 15 ft (5 m) above the trench bottom. The crib received both organic and aqueous plutonium waste solutions from the PFP Plutonium Scrap Recovery Facility from 1955 to 1962. The total volume of liquid discharged to the crib was 4.09E+06 L. The inputs to the trench included 163 metric tons of organics consisting of approximately 65% CCl_4.

The 216-Z-18 Crib consists of five parallel excavations, 210-by-10-by-20 ft (65-by-3-by-6 m) deep. A 300-ft long, 3-in. diameter (90 m-by-8 cm diameter) steel pipe runs east and west, bisecting the length of each excavation. The 100-ft long, 3-in. diameter (30 m long, 8 cm diameter), perforated, fiberglass-reinforced epoxy pipes exit each side of the above pipe in each excavation. The distribution pipes are 1 ft (0.3 m) above the crib bottom in a 2 ft (0.6 m) thick bed of 1.5-to-3 in. (3.5-to-7 cm) gravel. The gravel is covered by a membrane barrier overlain by approximately 6 in. (15 cm) of sand. The excavation is backfilled to grade. The crib received a total of 3.86E+06 L of waste from 1969 to 1973. There was a total of 260 metric tons of CCl_4 discharged to the crib, by far the largest hazardous chemical inventory received at the 216-Z-18 Crib. The description of the cribs are provided in Attachment 2.

2.3 Geology

The vadose zone underlying the area of CCl_4 discharge facility ranges in thickness from about 190 ft (60 m) at the 216-Z-9 Trench to 215 ft (65 m) at the 216-Z-18 Crib. A coarse-grained sand/mud sequence (the Hanford formation) forms the uppermost unit. A narrow paleo-flood channel trends north-south through the PFP area toward the 216-U Pond. This channel was cut into the fine-grained sequence and contains up to 130 ft (40 m) of relatively unconsolidated gravel and sand.

Underlying these sands and gravel is an unconsolidated, calcareous, fine sandy silt (early "Palouse" soil) which is 5-to-10 ft (1.5-to-3 m) thick under the CCl_4 discharge area. This unit thickens to the east, south, and west of the PFP, but is not present in the northeast portion of 200 West Area. Additional information regarding the geology of the region can be found in Attachment 2.

The glaciogluvial sediments of the "Hanford Formation" rest upon an eolian silt derived from subaerial erosion of the underlying Ringold Formation. Caliche horizons which are present within the eolian silt and the top of the Ringold Formation suggest deposition in an arid environment. A number of the wells drilled within the vicinity of the 216-A-1A Crib penetrate into or through the eolian silt unit. Samples indicate that the eolian silt is generally compact, buff-colored, and massive. A caliche content of greater than 7 percent is common. The thickness of the eolian silt averages 13 ft (4 m). The caliche layer underlying the 216-Z-1A Crib is generally 140 ft (44 m) below the Crib.

2.4 Hydrology

The fluvial-lacustrine Ringold Formation underlies the Plio-Pleistocene unit and overlies the Miocene Columbia River Basalt; the basalt generally provides the interface between the unconfined and confined aquifer systems. The silty-to-gravelly sand of the upper Ringold is discontinuous across the 200 West Area; it extends from the north as a narrow zone to just south of PFP, where it may be up to 22 ft (7 m) thick. The middle Ringold unit is a sandy gravel with occasional discontinuous thin zones of laminated sand. The water table lies in its upper portion. This unit is generally 250 ft (75 m) or more thick in the 200 West Area; the upper surface generally dips to the southwest, as do those of the underlying units.

On the average, field moisture contents of unsaturated sediments in 200 West Area range from 2 to 6 wt%. Several locally occurring zones of increased moisture content below about 40 ft (12 m) and within the Hanford formation may exist in the vicinity of PFP.

The unconfined aquifer is contained within the middle Ringold and underlying lower and basal Ringold units, which consists of fine-grained sequences underlain by a coarse-grained unit. The fine-grained sequences pinch out in the eastern portion of the 200 West Area. The saturated thickness of the unconfined aquifer is about 230 ft (70 m) thick underlying the PFP area.

Groundwater flow directions in the unconfined aquifer are generally radial outward from the southwestern portion of the 200 West Area primarily because of the continuing influence of the residual groundwater mound underlying the decommissioned 216-U Pond. Ground water flows generally toward the north, northwest, and northeast under the CCl_4 disposal sites. Based on tritium plume migration, Graham et al. (1981) estimated that average groundwater travel times are 80 to 120 yr from the 200 West Area to the Columbia River.

2.5 Meteorology

The prevailing wind direction at the 200 West Area is west-northwest or northwest wind the year around. The greatest wind speeds are from the southwesterly direction. Drainage winds occur with regularity in the summer, although these are seldom strong unless reinforced by frontal activity. In June, the month of highest average speed, there are fewer instances of hourly averages exceeding 30 mi/h (50 km/h) than in December, the month of the lowest speed.

In July, average wind speeds range from a low of 5 mi/h (8 km/h) to a high of 13 mi/h (21 km/h). In contrast, the corresponding speeds for January are 6 mi/h (9 km/h) to a high of 6.5 mi/h (10.5 km/h). Thunderstorms occur in every month of the year, but are very rare during the winter months. Although severe thunderstorms are rare, the site is vulnerable to lightning strikes causing grass fires, most notable in July/August time frame.

Average annual precipitation is 6 in. (15 cm); 43% of the annual precipitation occurs during November, December, and January, whereas only 10% occurs in July, August, and September. The driest month is July with 0.2 in. (0.5 cm) and the wettest month is January with 1 in. (2.5 cm).

2.6 Demography

The Hanford Meteorological Station (HMS) is used as the population reference point for the PFP area because of the availability of data and its proximity. Approximately 36 people live within a 10 mi (16 km) radius of the HMS with all of these individuals being located west-southwest of the HMS. The are no residents within the Hanford Site boundary. Within this boundary, only DOE, or contractor personnel, or other authorized persons are allowed to travel in areas beyond the Wye/Yakima Barricades. The closest resident to the 216-Z-1A Crib area is 7.7 mi (12.4 km) due west at a ranch at Cold Creek near State Highway 24 to Yakima.

2.7 Activity Description and Purpose

This preliminary activity will provide an evaluation of the effectiveness of the Vacuum Extraction System (VES). This evaluation is in support of the interim remedial action to prevent or minimize further spread of CCl_4 contamination to the groundwater in the vicinity of the 200 West Area. This was due principally to the downward diffusion of vapor phase CCl_4 through the vadose zone below these cribs encompassing a contaminant plume covering 7 mi^2 (11 km^2). This test involves extracting CCl_4 (and possibly other VOC's) over a period of two to three weeks to characterize the volume and nature of contaminants that can be extracted from the test well located south of the 216-Z-1A Crib. The extraction well will be perforated below the 100 ft (30 m) level at various intervals down to about the 135 ft (40 m) level which is close to the caliche layer.

Wells 299-W18-87 (drilled in 1969), 299-W18-150 (drilled in 1974), 299-W18-167 (drilled in 1977) will be used as observation wells during pumping of the test well by monitoring the airflow into these wells to provide information on the extent of the zone of influence for the extraction process. A calibrated flowmeter will continuously monitor the volume of vapor removed from the well and a vacuum gauge will monitor and control the vacuum applied to the well to maintain it at a steady pressure. During the first week of pumping, soil gas samples will be collected from the extraction air stream at various frequencies identified in Attachment 2. These samples will be analyzed onsite for volatile aromatic and halogenated hydrocarbons using a portable gas chromatograph.

The VES is designed as follows:

* The system will be constructed of PVC piping and flexible vacuum hose.

* Five gas sample ports will be installed upstream of the vacuum pump in the system. One closed loop sample port will be installed downstream of the vacuum pump. Two additional sample ports (one located after the first Granular Activated Carbon (GAC) canister and the other monitor located downstream of the second carbon canister will have two VOC monitors installed that will be electrically interlocked with the vacuum pumps automatically shutting down the system if one of these units alarms.

* Fifteen in-line sensors will be installed to indicate well head pressure, air temperature, differential pressure and flowrate. Sensors for providing pressure indication will be installed at each observation well.

* Three alpha Constant Air Monitors (CAMs) will be located in the system. The first CAM will be located downstream of the prefilter and the second CAM will be located between the two GAC canisters. The third alpha CAM, along with a single BETA CAM, will be located downstream of the HEPA filter.

* A single explosivity monitor will be located upstream of the air heater and prefilter.

* One electronic flowmeter will be installed downstream of the last CAM.

* There will be a non-contact electric air heater installed prior to the prefilter to raise the vented gas temperature and reduce its relative humidity.

* One in-line prefilter will be installed upstream of the carbon canisters and one in-line HEPA filter will be installed downstream from the carbon canisters and vacuum pump.

* Two 1,000 lbs (450 kgs) activated carbon canisters (2 canisters in series) will be the system used for absorbing and removing VOCs.

* There will be a combination of vacuum pumps, manifolded to provide flexibility to induce a range of venting vacuums and flowrates. The system is designed to produce a maximum of 500 cfm at 80-in. Wg (203 cm) vacuum.

A sketch of the equipment and overall system are provided in Attachment 3.

3.0 HAZARDS

3.1 Bases for Hazards Considered

An evaluation of the unmitigated intrinsic hazards associated with this project and the initiating events were assessed for their potential to create a source term release. These events and inventories were analyzed to determine which could result in credible accident events.

The results from the evaluations determined that high heat (fire), process hazards, lightning, heated carbon, high winds/missiles, seismic event, and dropping of a GAC canister were credible and that a flood was either incredible or would not result in any change in the impact of the event on the receptor groups and, therefore, would not require further analyses. Criticality was also assessed and determined not to be credible. A basis for these conclusions follows in this section.

3.2 Hazards Inventory

The dominant hazard inventory anticipated in the test has been determined to be CCl_4 as identified in Table 1. There were a number of other chemical contaminants that have been discarded to the cribs over the years that the PFP operated. The other hazard constituents identified are Tributylphosphate (TBP), Dibutylbutylphosphonate (DBBP), n-Butyl alcohol which is from possible hydrolysis of TBP and Chloroform which is a degradation product of CCl_4.

TABLE 1

Projected Hazards Inventory

Carbon Tetrachloride	1800 lb/820 kg

There have been other contaminants found in groundwater samples that intersect with the CCl_4 plume that has reached the groundwater. The contaminants identified are trichloroethylene, cyanide, fluoride, hexavalent chromium, trichlorethylene, nitrate, strontium^{90}, tritium, technetium^{99}, and iodine^{129}. These contaminants were not identified as constituents discarded to the 216-Z-1A Crib, but rather as contaminants that intersect with the CCl_4 plume.

The radionuclides discarded to the cribs were plutonium$^{239/240}$, americium^{241}, and uranium. The highest measured concentrations of plutonium$^{239/240}$ (4E+04 nCi/g) and americium^{241} (2.5+03 nCi/g) occurs in sediments located immediately beneath the crib. The high concentration of actinides at this location is possibly due to the filtering and ion exchange by sediments of plutonium oxide particles which were originally present in the waste stream as discussed in Attachment 4. The concentration of plutonium and americium in sediments generally decreases with depth beneath the bottom of the crib. An increase in plutonium and americium concentration at depth is generally associated with an increase in the silt content of sediments or with boundaries between sedimentary units. The bulk of the actinide contamination appears to be contained within the first 50 ft (15 m) of sediments beneath the bottom of the crib. The maximum vertical penetration of plutonium and americium contamination (defined by the 10^{-2} nCi/g isopleth)[2] is approximately 100 ft (30 m) below the bottom of the crib.

3.3 Vaporization of Contaminants

The process of vapor extraction technique relies on the process of vaporization, in which a liquid is converted to a vapor, Attachment 4. The ability of an element (or compound) to enter into the vapor phase, or to volatilize, is dependent on the vapor pressure, which is the vapor in equilibrium with the liquid or solid from which it originates.

The vapor pressure is a characteristic property of a given liquid or solid, and varies with the strength of the intermolecular forces. In the process of vaporization, molecules continually leave the substance in question until the starting substance is exhausted, exemplified in an open system, or until an equilibrium is reached, exemplified in a closed system. The vapor extraction technique emulates an open system by preventing equilibrium between the gas and the liquid.

Material with much higher vapor pressures than water will evaporate quicker or vaporize more readily. The CCl_4 is characteristic of a liquid with a much higher vapor pressure than water. To obtain a vapor pressure of 15 lbs/sq in. (760 mm Hg) a temperature of 170° F (76.7° C) is required, compared to 212° F (100° C) needed for water. In terms of a constant temperature, at 68° F (20° C), CCl_4 exhibits a vapor pressure of 1.7 lbs/sq in. (90 mm Hg), and water exhibits a vapor pressure of 0.34 lbs/sq in. (17.5 mm Hg).

The chemicals DBP and DBBP were identified as potential contaminants. These contaminants will not be extracted since the minimum pressure of 12.34 lbs/sq in. (638 mm Hg) that will be encountered in the ground using the VVE technique is not a low enough pressure to cause these chemicals to enter into the vapor phase. Table 2 identifies the temperatures at which the potential contaminants will boil at standard atmospheric pressure of 15 lbs/sq in. (760 mm Hg) and the vapor pressures (pressure required to boil) associated with a temperature of 68° F (20° C).

TABLE 2

Boiling Points and Vapor Pressures

Chemical	Boiling Point	Vapor Pressures at 68°F (20°C)
n-Butyl Alcohol	243.5°F (117.5°C)	0.14 lbs/sq in. (7.19 mm Hg)
Carbon Tetrachloride	170°F (76.7°C)	1.7 lbs/sq in. (90 mm Hg)
Chloroform	140°F (61°C)	3.0 lbs/sq in. (160 mm Hg)
Dibutylbutylphosphonate	480°F (250°C)	0.0003 lbs/sq in. (.0147 mm Hg)
Tributyl Phosphate	550°F (289°C)	0.00003 lbs/sq in. (.00143 mm Hg)

The plutonium, americium and uranium are not expected to be extracted during the test as discussed in Attachments 4 and 5. Metals as a class do not volatilize in the range of normal atmospheric pressures and temperatures. The melting points of plutonium and americium metals are 1185° F (640° C) and 2140° F (1173° C), respectively. For americium to vaporize, a temperature of 4712° F (2600° C) is required. For uranium to vaporize a temperature of 6872° F (3800° C) is required.

3.4 Credible Scenarios Analyzed

The predominant events analyzed are those associated with activities that would cause the contaminants to become airborne. There were several scenarios postulated that could cause a release of contaminants to the environment during normal operations or as a result of an accident. The analysis of the hazard inventories and the potential release mechanisms indicated that heat from a fire would produce the maximum source term. All of these scenarios involve inventories of CCl_4 that could be released to the environment.

High Heat:

The carbon, containing CCl_4, could be heated releasing the chemical inventory. An accident resulting in a fire could provide adequate temperatures to regenerate the carbon. Malfunction of equipment may possibly provide adequate temperatures needed to regenerate the carbon. In the event of a fire, the CCl_4 sorbate would be expected to be stripped from the carbon in 30 minutes at a temperature of 1750° F (955° C) (the time and temperature indicated is typical for thermal regeneration of granular activated carbon)[3].

Process Hazards:

One scenario involves CCl_4 vapors leaking around fittings or from flex hoses due to positive pressures in the system during normal operations. The worst case inventory released would be 235 lbs (106 kgs) of CCl_4 involving a release duration of 24 hours.

Another scenario involves the saturation of two carbon canisters causing CCl_4 to be pumped through the system and out the stack to the environment. The worst case inventory released would be 235 lbs (106 kgs) of CCl_4 involving a release duration of 24 hours.

3.5 Events Considered to Be Enveloped

Other events were considered, but not analyzed, that could lead to a hazard to the onsite or offsite individual. These events are enveloped by the analyzed credible events and the source terms produced from those events were determined to be greater.

Lightning:

The VVE test will not be conducted during the normal lightning season which is during the late summer months. Even in the event a lightning strike occurs at the work site, damaging a canister or piping containing CCl_4, the consequences of this event would be enveloped by the analysis involving a fire that heats the carbon, releasing CCl_4.

Heated Carbon:

The failure of the temperature control for the noncontact electric heater was evaluated based upon heating the carbon causing a regeneration of carbon releasing the CCl_4. The heater design indicated that 100° F (38° C) was the maximum temperature capacity for the unit. This temperature will not support regeneration of the carbon, but may result in some CCl_4 desorption. This case is bounded by the design basis fire scenario.

Dropped Canister:

There is a potential for dropping a fully loaded carbon canister during the process of changing out the canister. The carbon would be saturated with 300 lbs (140 kgs) of CCl_4. The canisters contain carbon with 95% of the carbon particles having a diameter greater than 847 microns. Particle sizes larger than 50 microns do not stay airborne very long unless there is considerable associated air turbulence or motion[4]. Particle sizes of physiological importance in man are less than 10 microns since larger particles are effectively removed in the nose and upper respiratory airways[5]. Based upon the particle sizes associated with the carbon the potential for a release of carbon particles in a high wind, seismic event, or if a canister is dropped appears unlikely and is not likely to be a hazard to the onsite worker.

High Winds/Missiles:

There is a remote potential that high winds may cause airborne missiles (scrap wood, miscellaneous items around the site, etc.) to be carried by high winds striking and penetrating a section of flex hose or a canister. The resulting release would not cause unacceptable consequences to the onsite/offsite individual.

Seismic Event:

The VVE system is designed to extract CCl_4 vapors from the soils (vadose zone). This system is not required to operate in order to provide confinement. In the event the system is damaged and not operable the extraction of CCl_4 vapors would not be possible. Any damage to piping or the carbon canisters would not cause CCl_4 vapors in the particulate to be released since the particle sizes of the carbon is too big.

Range Fire:

There have been range fires over the years on the Hanford Reservation. The consequences of a range fire would be enveloped by the analysis involving a fire that heats up the carbon and releases CCl_4.

3.6 Events Considered to Be Incredible

Criticality:

The criticality aspects associated with the test system were evaluated to ascertain whether some of the plutonium bearing waste solutions, discarded over the past decades to the 216-Z-1A Crib, could possibly be vaporized and draw off plutonium with the gases.

The VVE technique for extracting CCl_4 from soil below the crib cannot be expected to draw off any plutonium with the gases, or to cause any redistribution of the material trapped in the soil as addressed in Attachment 5.

Since none of the criticality safety assessments for plutonium in soil have ever accounted for the presence of high-neutron absorbers, like the chlorine of the CCl_4, the reduction of the chlorine content does not represent a new, unanalysed criticality hazard. Also, see section 3.3 and Attachment 4.

Flood:

The Columbia River probable maximum flood elevations (the flood discharge that may be expected from the most severe combination of meteorologic and hydrologic conditions reasonably possible in the region) would be about 425 ft (130 m) at the 100-N Area (with respect to mean sea level). This flood would not affect the central part of the site (the 200 East/West Areas' plateau), where the cribs are located since this area has an elevation of greater than 500 ft (150 m). Similarly, waters of the 100-year flood would have no effect on this area. Therefore a flood affecting this site is considered incredible.

3.7 Threshold Values

The inventory and resulting source terms analyzed were for CCl_4. The other VOC's that could possibly be extracted (based upon the temperatures and pressures required to vaporize these contaminants) consist of chloroform, n-butyl alcohol and trichloroethylene. The quantities of these other contaminants are much smaller than the quantities of CCl_4 and the toxicity of both chloroform and trichloroethylene are less than CCl_4 and are therefore enveloped by the CCl_4 analysis.

The toxicity limit values for the chemical contaminants identified in this section are provided in Table 3. These limits were derived from the guidelines using the concentration values reported in the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents[6] and the National Institute of Occupational Safety and Health (NIOSH) standards[7].

TABLE 3

Toxicity Limit Values

Inventory/Contaminants	IDLH*	TWA**		TLV-C***	
	ppm	ppm	mg/m^3	ppm	mg/m^3
n-Butyl Alcohol	8000	50	152	--	----
Carbon Tetrachloride****	300	5	31	25	157
Chloroform****	1000	10	49	60	293
Trichloroethylene	1000	50	269	200	1075

* IDLH = The Immediately Dangerous to Life or Health (IDLH) level represents a maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

** TWA = The Time-Weighted Average (TWA) concentration for a normal 8-hour work-day and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect (The term "TWA" may be expressed in either ppm or mg/m^3).

*** TLV-C= The Threshold Limit Value-Ceiling is the concentration that should not be exceeded at any time during any part of the working exposure.

**** SHC = The Suspected Human Carcinogens (SHC) are chemical substances or substances associated with industrial processes, which are suspect of inducing cancer, based on either limited epidemiological evidence or demonstration of carcinogenesis in one or more animal species by appropriate methods.

3.8 Assessment Results

This assessment analyzed CCl_4 as the accident inventory since CCl_4 is the only actual inventory identified (with known quantities of CCl_4) that will be removed as a result of the VVE test. The location of the closest onsite facility to the test well is the PFP. The offsite location is Highway 240 which is 2.8 mi (4.5 km) from the well location. The site boundary (nearest resident) is 7.7 mi (12.4 km).

Two scenarios were postulated involving positive pressures and saturation of carbon that could cause a release of CCl_4 that may result in a source term. Both of these accidents involve an inventory of 235 lbs (107 kgs) of CCl_4 being released over a 24 hour period. A summary of the receptor exposures are shown in Table 4.

TABLE 4

Receptor Exposures For 24 Hour Release of CCl_4

Hazard Source	Resultant Exposures			Limits		
Carbon Tetra-chloride	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA	TLV-C
235 lb/day	1.5 ppm 9.4 mg/m^3	0.01ppm 0.06mg/m^3	0.002ppm 0.013mg/m^3	300ppm 1882mg/m^3	5 ppm 31 mg/m^3	25 ppm 157mg/m^3

One scenario has been developed that involves heating saturated carbon canisters due to a fire. Since CCl_4 is non-combustible, a fire scenario was identified that would result in a source term, involving a truck containing 250 gal (946 L) of diesel fuel (diesel fuel yields measured flame temperatures for open burning in the range from 1400° F (760° C) to 2400° F (1315° C))[8] and from one to six canisters saturated with CCl_4 (calculations are included for the limiting scenario of six). The heat from the fuel fire would strip and release the toxic pollutants in the smoke plume. The burn rate for diesel fuel is 31.4 $g/m_2/s$[9]. The release rate used for a 30 minute release was .333 lbs (0.151 kgs/s). This fire scenario is the bounding inventory, involving a maximum of 1800 lbs (820 kgs) of CCl_4. The receptor exposures involving CCl_4 are identified in Table 5.

This fire scenario was analyzed for a continuous (30 min.) release period. Calculations were done using the WHAZAN plume model at 50% meteorology ("normal") conditions at wind speeds of 4 m/s[10].

TABLE 5

Receptor Exposures For 30 Minute Release of CCl_4

Hazard Source	Resultant Exposures			Limits		
Carbon Tetra-chloride	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA	TLV-C
1800 lb	278 ppm 1744mg/m^3	1.28 ppm 8.03mg/m^3	0.38 ppm 2.38mg/m^3	300 ppm 1882mg/m^3	5 ppm 31mg/m^3	2.5 ppm 157mg/m^3

The CCl_4 can be broken down by heat and, in the presence of oxygen, forms small quantities of phosgene gas. The generation rate of phosgene gas was estimated from information given in the literature on phosgene concentrations from fires and from a knowledge of total combustion gas volumetric generation rate for the scenario in question[11]. WHAZAN calculations were done to predict generated phosgene gas.

Table 6 provides a summary of the receptor exposures based upon phosgene released over a 30 minute period.

TABLE 6

Receptor Exposures For 30 Minute Release of Phosgene

Hazard Source	Resultant Exposures			Limits		
Phosgene	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA	TLV-C
	0.13 ppm 0.53 mg/m^3	<0.05ppm <.20mg/m^3	<0.05ppm <.20mg/m^3	2 ppm 8.10mg/m^3	0.1 ppm .40mg/m^3	0.2 ppm 0.81mg/m^3

Attachment 6 provides the backup data and analysis for the receptor exposures identified in Tables 4, 5, and 6.

4.0 SAFETY FUNCTIONS AND CONTROLS

The analysis disclosed that the test would be classified as a low hazard operation provided the inventory of CCl_4, absorbed on the carbon exposed to the heat from a fire, does not exceed 1800 lbs (820 kgs). The safety function that will be provided for the remediation activities of the CCl_4 vapor vacuum extraction test system (Task # 7) operation is identified in an Operational Safety Limit (OSL). The following is the OSL for the 200 West Area CCl_4 Expedited Response Action.

4.1 OPERATIONAL SAFETY LIMIT

LIMITING THE INVENTORY OF CCl_4 THAT CAN BE RELEASED FROM THE OPERATION OF THE VAPOR VACUUM EXTRACTION SYSTEM

4.1.1 Applicability:

This limit applies to the inventory of CCl_4 and accumulation area for storage of fully saturated canisters during the conduct of Task # 7.

4.1.2 Objective:

This limit assures that Task # 7 of the 200 West Area CCl_4 Expedited Response Action is operated within the guidelines of the safety assessment and assures the potential hazards to the onsite/offsite individual and environment are minimized.

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4.1.3 Requirement:

The total inventory of CCl_4, adsorbed in the carbon canisters, shall not exceed 1800 lbs (820 kgs) at any one accumulation location. Canisters that contain CCl_4 shall be stored such that a common mode fire would not affect another accumulation area. The inventory of CCl_4 shall be identified on each canister, with a running inventory maintained for the total quantities at the accumulation area. In the event the inventory of CCl_4 cannot be measured, the total number of fully or partially saturated carbon canisters shall be limited to their combined capacity of 1800 pounds CCl_4. A total of six canisters fully saturated with CCl_4 would not exceed the total inventory of 1800 lbs (820 kgs) of CCl_4.

4.1.4 Surveillance:

The responsible operating organization shall verify daily (during periods of operation) that the work site is in compliance with the requirements. Compliance with the stated requirements shall be documented in an auditable record.

4.1.5 Recovery

4.1.5.1 Non-compliance with the requirements of the OSL:

1. Extraction operations shall cease until Health and Safety Assurance approves restart of the operation.

2. The Fire Department will be notified requesting they standby at the work site until recovery actions are complete.

3. The accumulated CCl_4 inventory shall be reduced to less than 1800 lbs (820 Kgs) within eight hours.

4. An OSL violation shall be documented as an unusual occurrence report.

4.1.5.2 Non-compliance with the surveillance requirement:

1. The surveillance shall be performed immediately.

2. If surveillance determines non-compliance with the requirement then initiate recovery actions as identified in section 4.1.5.1.

3. Failure to implement a surveillance requirement shall be documented as an off-normal occurrence.

4.1.6 Audit Point:

Formal documentation shall be audited weekly assuring compliance with the requirements and surveillance.

4.1.7 Bases:

Limiting the inventory of carbon tetrachloride is necessary to assure that an accident involving a fire would not result in consequences to the onsite/offsite worker that exceed the concentration limits for carbon tetrachloride and maintain those limits within allowable levels. It is assumed that a 1,000 lb (450 kg) carbon canister absorbs 300 lbs (136 kgs) of CCl_4.

4.2 Prudent Actions

This assessment also indicates that a fire involving CCl_4 may cause unacceptable receptor exposures that exceed the TLC-C ceiling limits at PFP. Prudent actions are being recommended for minimizing potential exposures of CCl_4 to protect the Hanford Site worker and personnel at PFP.

Function:

Reduce the receptor exposures that may exceed the TLC-C ceiling limits.

Prudent Action:

Provide barriers to protect the canisters being used in the vapor vacuum extraction test system from high heat, i. e., > 1700° F (925°C) or assure that the PFP can be notified within 10 minutes that a fire involving CCl_4 has occurred and to evacuate. An emergency response plan should be developed and in place at PFP for identifying response actions associated with a VVE fire involving CCl_4 fire.

Function:

Minimize exposure of site personnel to Volatile Organic Compounds from leaks that may occur in the test system.

Prudent Action:

Monitor fittings and positive pressure points in the system.

Function:

Minimize potential missile damage to canisters during high winds..

Prudent Action:

Maintain work area free of materials that could become missiles during periods of high winds.

Function:

Assure test area is free of vegetation and combustibles.

<u>Prudent Action:</u>

Clear the test site and nearby surrounding area of vegetation and remove combustibles not necessary to the project.

<u>Function:</u>

Assure that the Hanford Fire Department and other emergency response organizations are made aware of this remediation activity including the potential hazards.

<u>Prudent Action:</u>

Apprise the Hanford Fire Department and the Emergency Planning organizations of the potential hazards associated with this remediation activity.

<u>Function:</u>

Monitor for radionuclides.

<u>Prudent Action:</u>

Even though plutonium and americium are not expected to be removed during the test, provide monitoring for radioactive contamination. In the event there is a CAM alarm indicating radioactive contamination, shut down the process. Concurrence for restart will be required from the Site Safety Officer or the Health Physics Technician.

<u>Function:</u>

Monitor for explosive gases.

<u>Prudent Action:</u>

The explosivity monitor is calibrated such that detection of the chemical with the lowest Lower Explosive Limit (LEL) will be detected (of the contaminants that will be extracted, n-butyl alcohol is the chemical identified in this assessment with the lowest LEL).

5.0 REFERENCES:

1. Implementation Guideline for Hazard Documentation, WHC-SD-GN-ER-301, Revision 0, Prepared by Regulatory Policy, September 1990.

2. Distribution of Plutonium and Americium Beneath the 216-Z-1A Crib: A Status Report, Rockwell International, RHO-ST-17, S. M. Price, February 1979.

3. Carbon Adsorption Handbook, P. N. Cheremisinoff and F. Ellerbusch, published 1978.

4. Compilation of Air Pollutant Emission Factors, Volume 1, Stationary Point and Area Sources, Fourth Edition, September 1985.

5. Air Pollution Manual, Part II, Published by American Industrial Hygiene Association, 1968.

6. 1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH).

7. National Institute of Occupational Safety and Health (NIOSH), Pocket Guide to Chemical Hazards, June 1990.

8. Severities of Transportation Accidents, published by Sandia Laboratories, July 1976.

9. Heat Release Rate in Fire, A. Tewarson, Factory Mutual Research Corporation, Norwood, MA, 02062. Fire and Materials, Volume 4, number 4, 1980.

10. Controlled Manual Waiver Request, WA-007, Approved, March 19, 1991.

11. Determinaticn of Phosgene, 0148208, N105H-00060319 Yant, Industrial and Engineering Chemistry, Analytical Edition, Volume 8, Number 1, Pages 20-25, January 15, 1936.

ATTACHMENT 1

WELL 299-W18-171

CONSTRUCTION SUMMARY

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WELL 299-W18-171 CONSTRUCTION SUMMARY

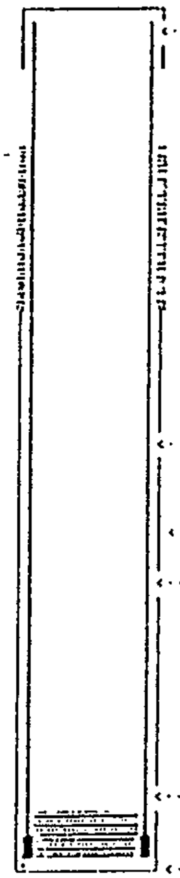
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-W18-171 TEMPORARY WELL NO:
Drilling Fluid Used: None	Additives Used: Not documented	Hanford Coordinates: N/S N 39,010 E/W W 76,504
Driller's Name: Baker	WA State Lic Nr: Not documented	State Coordinates: N 444,115 E 2,218,621
Drilling Company: Not documented	Company Location: ND	Start Card #: Not documented T___ R___ S___
Date Started: 26Jul77	Date Complete: 09Aug77	Elevation Ground surface (ft): Not documented

Depth to water: Not applicable

GENERALIZED STRATIGRAPHY | Driller's Log

0-25: Med-very coarse SAND, PEBBLES (Fill)
25-27.5: Med-coarse SAND
27.5-37.5: Med SAND
37.5-43: Coarse-very coarse SAND, w/PEBBLES & COBBLES
43-47: Fine-very coarse SAND, w/PEBBLES & COBBLES
47-48: Fine-very coarse SAND & GRAVEL
48-49: Med SAND
49-51: Fine-very coarse SAND & GRAVEL
51-53: Med SAND
53-58: Very fine-fine SAND
58-62: Fine-med-coarse SAND
62-65: Med SAND (Dry)
65-67: Very fine-fine SAND
67-69: Silty very fine SAND
69-72.5: Fine-med SAND
72.5-75: Fine-coarse-very coarse SAND
75-87: Very fine-med SAND
87-88: Silty-very fine-fine-med SAND
88-91: Med SAND
91-93: Med-coarse SAND
93-95: Fine-coarse SAND
95-98: Very fine-coarse SAND
98-99: Fine-coarse SAND w/SILT stringers, few PEBBLES, COBBLES
99-102: Med-very coarse SAND, w/PEBBLES, COBBLES
102-103.5: Fine-very coarse SAND, PEBBLES
103.5-105: Coarse-very coarse SAND & pea GRAVEL, few COBBLES
105-107: Very fine-very coarse SAND w/PEBBLES & COBBLES
107-119: Med-very coarse SAND, PEBBLES & COBBLES
119-121: Coarse-very coarse SAND, PEBBLES 50%
121-125: Fine-med-very coarse SAND, pea GRAVEL
125-125.5: Very fine-med SAND, few PEBBLES
125.5-127: Very fine SAND-SILT
127-132: SILT
132-136: SILT, some $CaCO_3$



Elevation of reference point: (top of casing) [677.65 ft]
Height of reference point above ground surface [ND]
Depth of surface seal [ND]
Type of surface seal: Cement grout
I.D. of surface casing (if present) [ND]
I.D. of riser pipe: [8-in]
Type of riser pipe: Carbon steel
Diameter of borehole: [9-in nom]
Type of filler: Not documented
Cement plug in bottom, not well documented
Depth bottom of casing
Depth bottom of borehole: [136 ft]

DRILLER'S NOTES:
Contamination encountered:
87 ft = 20,000 dp/m
87.5 ft = 20,000 dp/m

Drawing By: RKL/2W18-171.ASB Date: 11Dec90

Reference: ____________

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ATTACHMENT 2

200 WEST AREA

CARBON TETRACHLORIDE

INTERIM RESPONSE ACTION PROJECT PLAN

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200 WEST AREA CARBON TETRACHLORIDE

INTERIM RESPONSE ACTION

PROJECT PLAN

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January 9, 1991

Westinghouse Hanford Company
Richland, Washington 99352

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CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE.

This document provides a description of the 200 West Area Carbon Tetrachloride Interim Response Action (IRA) Project, as requested by the December 20, 1990 letter from the U.S. Environmental Protection Agency (EPA) and the Washington Department of Ecology (Ecology) to the U.S. Department of Energy-Richland Operations Office (DOE-RL) (see Exhibit 1). The project plan includes a description of the site, a preliminary screening of remedial action technologies, site evaluation tasks to be performed, and brief descriptions of the IRA proposal, design, implementation, reporting, and project schedule information.

1.2 BACKGROUND

An IRA is a provision included in the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) that allows for expedited responses to be taken at waste sites where early remediation will prevent the potential for an imminent hazard to develop. The IRA is implemented according to the requirements outlined in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1989, Part 3, Article XIII, Section 38), and in accordance with 40 CFR Part 300, Subpart E.

On October 18, 1990, an Agreement in Principle between DOE, EPA, and Ecology was signed (Exhibit 2). This agreement states that three candidate projects will be considered for expedited response actions. The agreement states that candidate projects under consideration include, but are not limited to:

- 618-9 Burial Ground
- 300 Area Process Trenches
- 200 West Area Carbon Tetrachloride.

On December 6, 1990, DOE-RL submitted (see Exhibit 3) the preliminary proposed interim response action summary packages which included a summary package on the 200 West Area Carbon Tetrachloride IRA. On December 12, 1990, Ecology responded with comments on the proposed 200 West Carbon Tetrachloride IRA (see Exhibit 4). On December 20, 1990, both the EPA and Ecology requested DOE-RL to proceed with detailed planning to implement the 200 West Area Carbon Tetrachloride IRA (see Exhibit 1).

1.3 GENERAL CONCEPT OF IRA

The goal of the 200 West Area Carbon Tetrachloride IRA is to minimize or stabilize the spread of carbon tetrachloride within the unsaturated soils (vadose zone) beneath, and away from principal carbon tetrachloride disposal sites in the 200 West Area in the vicinity of Z Plant. This action would be conducted until final cleanup can be achieved through the implementation of the CERCLA process at the 200-ZP-1 and-2 operable units.

The IRA will not be performed on the Carbon Tetrachloride found in the groundwater in the 200 West Area due to the complexity of recovering the carbon tetrachloride in an IRA time frame and its anticipated lesser chance of success when compared to remediation of the vadose zone.

The process for implementing the 200 West Area carbon tetrachloride IRA will follow the format outlined in the Tri-Party Agreement, and the Hanford Site Past Practice Investigation Strategy Document (Draft, October 1990). The IRA is considered to be non-time critical, meaning that a planning period of at least 6 months exists prior to initiation of the activity. Implementation of a non-time-critical IRA requires an engineering evaluation/cost assessment to be conducted and submitted to the lead regulatory agency (EPA). In the case of the Hanford Site strategy for performing an IRA, the engineering evaluation/ cost assessment will be contained in an IRA proposal which will provide the additional details necessary for implementing the alternative chosen. The IRA proposal is preceded by an initial site evaluation phase and followed by the design and implementation of the IRA selected.

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2.0 SITE CHARACTERISTICS

2.1 PHYSICAL CHARACTERISTICS

2.1.1 Liquid Waste Disposal Facilities

Aqueous and organic waste from plutonium recovery processes operated at Z Plant in the 200 West Area were discharged primarily to three liquid waste disposal facilities: the 216-Z-1A Tile Field, the 216-Z-9 Trench, and the 216-Z-18 Crib (Figure 1).

The 216-Z-1A Tile Field has surface dimensions of approximately 200 by 360 ft. The side walls of the 19-ft-deep excavation were sloped inward, resulting in a floor dimension for the facility of approximately 115 by 275 ft. The floor of the excavation was covered by a 4-ft-thick cobble layer with a minimum north-to-south surface slope of 1%. A herringbone pattern of 8-in-diameter clay pipe, comprised of a 260-ft-long central distributor pipe and seven pairs of 70-ft laterals, was placed on this cobble layer. The 98- by 260-ft rectangular area covered by the piping system was then overlain with 0.5 ft of cobbles and 5 ft of sand and gravel. A sheet of 0.02-in. polyethelene covered by 1 ft of sand and gravel was also added to the facility. The surface of the tile field appears to be about 8 ft below grade. Effluent piping in the 216-Z-1A Tile Field is vitrified clay pipe; the central distribution pipe has a stainless steel pipe inside the clay pipe (Price et al. 1979; Owens 1981).

The base of the 216-Z-9 Trench is a 60- by 30-ft excavation, 21 ft deep. The surface is a 120- by 90- by 0.75-ft-thick concrete trench cover at ground level. Two 1.5-in. stainless steel pipes discharged liquid 17 ft above the trench bottom. The concrete pad is supported by six 23-ft-tall concrete columns. The site contains equipment from 1976-1978 mining operations (Owens 1981).

The 216-Z-18 Crib consists of five parallel excavations, 207- by 10- by 18-ft deep. A 300-ft-long, 3-in-diameter steel pipe runs east and west, bisecting the length of each excavation. Two 100-ft-long, 3-in-diameter, perforated, fiberglass-reinforced epoxy pipes exit each side of the above pipe in each excavation (two lines north, two lines south). The distribution pipes are 1 ft above the crib bottom in a 2-ft-thick bed of 1.5- to 3-in. gravel. The gravel is covered by a membrane barrier overlain by approximately 6 in. of sand. The excavation is backfilled to grade (Owens 1981).

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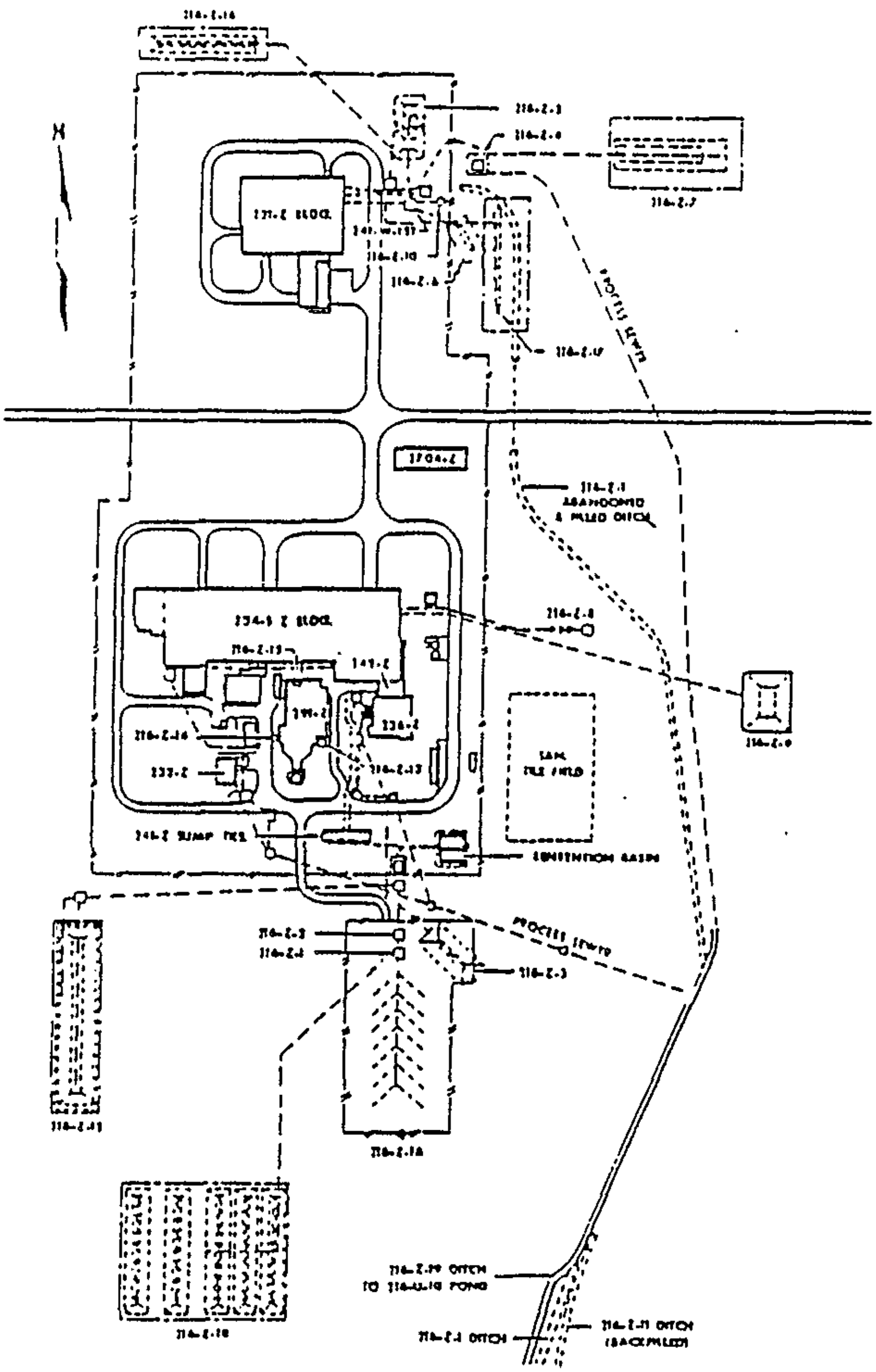

Figure 1. Z Plant Liquid Waste Sites.

2.1.2 Geology/Hydrogeology

The vadose zone underlying the area of carbon tetrachloride discharge facilities ranges in thickness from about 190 ft at the 216-Z-9 Trench to 215 ft at the 216-Z-18 Crib. A coarse-grained sand/gravel sequence underlain by a fine-grained sand/mud sequence (the Hanford formation) forms the uppermost unit. A narrow paleo-flood channel trends north-south through the Z Plant area toward 216-U Pond; this channel was cut into the fine-grained sequence and contains up to 130 ft of relatively unconsolidated gravels and sands (Last et al. 1989).

Underlying these sands and gravels is an unconsolidated, calcareous, fine sandy silt (early "Palouse" soil) which is 5 to 10 ft thick under the carbon tetrachloride discharge area. This unit thickens to the east, south, and west of Z Plant, but is not present in the northeast portion of 200 West Area.

The Plio-Pleistocene paleosurface underlying the silt is characterized by relatively high concentrations of calcium carbonate cement (8 to 30 wt%) and ranges from a gravelly sand to a sandy mud. The thickness varies from about 14 to 25 ft in the vicinity of Z Plant. The surface of this unit dips to the southwest across the 200 West Area but includes local undulations in the vicinity of Z Plant. The high cementation and laterally continuous nature of this unit may create a layer with relatively low permeability throughout the 200 West Area.

The fluvial-lacustrine Ringold Formation underlies the Plio-Pleistocene unit and overlies the Miocene Columbia River Basalt; the basalt generally provides the interface between the unconfined and confined aquifer systems. The silty-to-gravelly sand of the upper Ringold is discontinuous across the 200 West Area; it extends from the north as a narrow zone to just south of Z Plant, where it may be up to 22 ft thick. The middle Ringold unit is a sandy gravel with occasional discontinuous thin zones of laminated sand. The water table lies in its upper portion. This unit is generally 250 ft or more thick in the 200 West Area; the upper surface generally dips to the southwest, as do those of the underlying units.

On the average, field moisture contents of unsaturated sediments in 200 West Area range from 2 to 6 wt% (Last et al. 1989). Several locally occurring zones of increased moisture content below about 40 ft and within the Hanford formation may exist in the vicinity of Z Plant.

The unconfined aquifer is contained within the middle Ringold and underlying lower and basal Ringold units, which consist of fine-grained sequences underlain by a coarse-grained unit. The fine-grained sequences pinch out in the eastern portion of 200 West Area. The saturated thickness of the unconfined aquifer is about 230 ft thick underlying Z Plant.

Groundwater flow directions in the unconfined aquifer are generally radial outward from the southwestern portion of the 200 West Area primarily because of the continuing influence of the residual groundwater mound underlying the decommissioned 216-U Pond. Groundwater flows generally toward the north, northwest, and northeast under the carbon tetrachloride disposal sites. Based on tritium plume migration, Graham et al. (1981) estimated that average groundwater travel times are 80 to 120 yr from the 200 West Area to the Columbia River.

2.2 NATURE AND EXTENT OF CONTAMINATION

2.2.1 Contaminant Sources

The aqueous waste stream, characterized as a high-salt aqueous waste, was primarily a concentrated (5M to 6M), acidic (pH ~ 1.0 to 2.5), sodium nitrate solution. In addition to the aqueous phase, organic liquids consisting of carbon tetrachloride (CCl_4), tributylphosphate (TBP), and dibutylbutylphosphonate (DBBP) occurred in saturation amounts in the aqueous phase and were also discharged separately in batches. Less than 5% of the volume of high-salt aqueous waste consisted of the organic component (Kasper 1982).

The 216-Z-9 Trench was built for the disposal of both organic and aqueous plutonium waste solutions from the Recuplex Plutonium Scrap Recovery Facility in the 234-5 Z Plant. The 216-Z-9 Trench received recuplex high-salt, aqueous waste and organic waste from July 1955 to June 1962. The total volume of liquid discharged was 4.09E+06 L. The recuplex inputs to the trench included: 109 metric tons of organic as 15-25% TBP in CCl_4, DBBP, and trace monobutylphosphate; and 54 metric tons of organic as "fab oil" (a mixture of 50% CCl_4/50% lard oil used as a cutting oil during the machining of plutonium) (Owens 1981).

In 1964, the 216-Z-1A Tile Field was reactivated to receive aqueous and organic waste from the Plutonium Reclamation Facility in the 236-Z Building and the 242-Z Waste Treatment and Americium Recovery Building. The tile field received approximately 5.2E+06 L of waste between June 1964 and June 1969 (Price et al. 1979). The amount of organic material being discharged to the tile field in 1967 was estimated to be: 80 vol% CCl_4/20 vol% TBP at a rate of 4,400 gal/yr; 70 vol% CCl_4/30 vol% DBBP at a rate of 6,600 gal/yr. Fab oil was not included in these estimates because of its intermittent processing and the relatively small volume involved at that time. In 1967, about 6,000 gal of fab oil remained in storage to be processed and routed to 216-Z-1A (Sloat 1967). If the rate of input of organic remained constant during the 5-yr period (1964-1969), the crib would have received about 245 metric tons of CCl_4.

The use of the 216-Z-1A Crib was terminated in 1969, and the waste stream was rerouted to the 216-Z-18 Crib. The 216-Z-18 Crib received a total of 3.86E+06 L of waste from June 1969 to May 1973 (Owens 1981). The hazardous chemical inventory in the waste identification data system (WHC 1990) indicates 260 metric tons of CCl_4, 15 metric tons of dibutylphosphate, and 22 metric tons of TBP were discharged to the 216-Z-18 Crib.

The chemical processes used to purify plutonium resulted in the production of actinide-bearing waste liquid; the primary radionuclide component of this liquid discharged to the CCl_4 liquid waste disposal sites was plutonium-239/240. The 216-Z-1A Crib received an estimated 57 kg of plutonium; 216-Z-9 Trench received 48 kg; and the 216-Z-18 Crib received 23 kg (Owens 1981).

2.2.2 Groundwater Contamination

The CCl_4 groundwater contaminant plume, as defined by the 50 p/b contour (10 times the MCL of 5 p/b) in Evans et al. (1990), covers at least 2 mi^2, virtually all of the 200 West Area north and east of the CCl_4 discharge area. Maximum concentrations in the upper part of the aquifer (8,700 p/b at well 299-W15-16 in 1990) occur approximately 1,500 ft downgradient from the 216-Z-1A and 216-Z-18 cribs. A concentration of 5 p/b was observed in a companion well (299-W15-17) screened in the lower portion of the aquifer.

In addition to carbon tetrachloride, a chloroform plume of more limited extent appears centered between Z Plant and the 216-Z-9 Crib. The maximum observed concentration of chloroform exceeds 650 p/b; the maximum contaminant level is 100 p/b. Evans et al. (1990) suggest that the chloroform is probably a degradation product of the carbon tetrachloride, either through radiolytic processes prior to disposal or through natural transformation processes in the subsurface. Other groundwater contaminants indicated in Evans et al. (1990) which currently intersect the CCl_4 plume include: cyanide, fluoride, hexavalent chromium, trichloroethylene, nitrate, strontium-90, tritium, technetium-99, iodine-129, and uranium.

2.2.3 Soil Contamination

In 1979 at the 216-Z-1A Tile Field, the highest measured concentrations of plutonium-239/2240 (4E+04 nCi/g) and americium-241 (2.5E+03 nCi/g) occurred in sediments located immediately beneath the crib. The concentration of actinides in sediments generally decreased with depth beneath the crib, with the exception of silt-enriched horizons and boundary areas between major sedimentary units. The maximum vertical penetration of actinide contamination (defined by the 1E-02 nCi/g isopleth) was located approximately 100 ft below the bottom of the crib. The estimated lateral extent of contamination is located within a 30-ft-wide zone around the crib (Price et al. 1979). Of the three CCl_4 disposal sites, the 216-Z-1A Tile Field received the largest volume of waste liquid and the largest amount of plutonium. The plutonium and americium is therefore assumed to be held within the upper 100 ft of sediment underlying the 216-Z-9 Trench and 216-Z-18 Crib.

Carbon tetrachloride vapors have been detected during drilling at numerous sites in the 200 West Area. For example, anecdotal reports indicate that CCl_4 vapors were encountered above the Plio-Pleistocene layer ("caliche layer") during drilling of the 216-Z-1A Tile Field after its retirement in 1969; that vapors were encountered below the caliche layer during remediation of wells at the 216-Z-9 Crib in 1987; that vapors are encountered below the caliche layer during drilling of Resource Conservation and Recovery Act of 1976 (RCRA) wells near U and T Tank Farms in 1990.

3.0 PRELIMINARY SCREENING OF ALTERNATIVES

3.1 INTRODUCTION

This section provides a preliminary evaluation of remedial action alternatives for conducting an interim remedial action to prevent or minimize further spread of carbon tetrachloride contamination to the groundwater in the vicinity of the 200 West Area. Results from this preliminary evaluation will be used to better focus site evaluation tasks (Chapter 4.0) and provide input into the development of the IRA Proposal (see Chapter 5.0). This evaluation is not intended as a formal screening as conducted in the engineering evaluation/cost assessment (see Chapter 5.0).

3.2 IRA GOAL AND EVALUATION

Transport of carbon tetrachloride in the groundwater around the 200 West Area is currently believed to be due principally to the downward diffusion of vapor phase carbon tetrachloride through the vadose zone. The goal of the remedial action is therefore to remove carbon tetrachloride vapor from the unsaturated zone to prevent further contamination of the groundwater. Direct cleanup of the groundwater will not be considered further, as groundwater remedial cleanup alternatives would be relatively less efficient, more costly, and could not be performed in the timeframe of an IRA.

The general response actions considered for the Carbon Tetrachloride IRA are:

- no action
- institutional
- containment
- collection and treatment
- in situ treatment.

These response actions are screened using feasibility, appropriateness, and cost as the selection criteria.

A "no action" alternative does not meet the goal of the IRA and is therefore not considered further. An "institutional" action alternative is not considered for the same reasons. A preliminary evaluation of technologies associated with the remaining three response actions are presented in Table 3-1.

Based on the preliminary evaluation, a form of soil gas extraction, with or without accompanying injection or enhanced removal, is the preferred alternative for collection of the carbon tetrachloride vapor. The treatment process for the vapor once aboveground is likely a carbon absorption system or a form of thermal treatment. These alternatives will be further evaluated as part of the IRA Proposal (engineering evaluation/cost assessment).

Table 3-1. Potential Viable Technologies for Remediation of Contaminated Soil (Page 1 of 2)

Remedial Technology	Process Description	Comments	Retain for Further Evaluation[a]
A. CONTAINMENT			
a. Ground Freezing:	Coolant is circulated in loops in the ground to temporarily freeze the soil and make it less permeable.	Not cost effective for great thicknesses of contaminated soil. Not a well-tested technology.	No
b. Stabilization/ Solidification:	Processes reduce the movement by physical entrapment.	Limited effectives for the depth and thickness of the contaminated vadose. Reliability is uncertain.	No
B. COLLECTION			
a. Excavation and Removal:	Removal of contaminated soil by common construction equipment.	Prohibitive depth of contaminated soils. Large volumes for disposal.	No
b. Extraction			
Extraction Wells:	Removal of soil gas by vacuum pumping.	Extraction wells feasible. May require soil gas treatment. Could use existing vertical or new vertical wells. Horizontal wells may not be feasible due to nature and depth of the vadose sediments.	Yes
Injection Wells:	Inject air (or other gas) to flush contaminated soils (used with extraction wells or collection system).	Injection wells feasible. Injection could flush contaminants into the groundwater. Could use existing or new wells.	Yes

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Table 3-1. Potential Viable Technologies for Remediation of Contaminated Soil (Page 2 of 2)

Remedial Technology	Process Description	Comments	Retain for Further Evaluation[a]
Enhanced Removal:	Injection of chemicals into the aquifer to aid in contaminant removal from the aquifer.	Not applicable to large volumes of soils with complex waste mixtures. Increasing mobility of contaminants could increase migration.	No
C. <u>TREATMENT</u>			
a. No Treatment	Carbon Tetrachloride gases are vented directly to the air.	Feasible, dependent upon regulatory requirements.	Yes
b. Biological Treatment: (Including in situ treatment)	Microorganisms metabolize hazardous organic compounds rendering them nonhazardous.	Not feasible for the short timeframe of an IRA.	No
c. Physical Treatment -			
Carbon Absorption:	Organic compounds are absorbed and retained on the carbon media.	Reliable and applicable for carbon tetrachloride vapor.	Yes
d. Thermal Treatment:	Heat is applied to thermally destroy hazardous organic compounds.	Reliable and applicable for carbon tetrachloride vapor.	Yes

[a]Remedial technologies not retained willbe given further consideration during the IRA engineering evaluation/cost assessment (see Chapter 5.0).

4.0 PHASE I SITE EVALUATION

4.1 DATA COMPILATION AND REVIEW TASKS

The site evaluation is focused on determining vadose zone physical and chemical properties because the IRA will focus on remediation of the carbon tetrachloride vapor in the vadose zone (Chapter 3.0). In addition, the preliminary assessment of potential remediation technologies suggests a form of soil vapor extraction will be used. Therefore, site evaluation is also focused on providing design input for this process.

The principal purposes of site evaluation are to verify and refine the conceptual model of contaminant identity and distribution and to investigate and quantify the physical characteristics of the vadose zone. Site evaluation will be conducted in a phased approach and in parallel with the preparation of the engineering evaluation/cost assessment. Phase I of the site evaluation will include compiling and reviewing existing data, sampling and analysis of soil gas and groundwater, testing vacuum extraction equipment, and numerical modeling. Initial data needs include:

- assessment of the suitability of existing structures (i.e., wells, vents, piping) for use in characterization and remediation
- lateral and vertical distribution of carbon tetrachloride in the vadose zone
- lateral and vertical distribution of carbon tetrachloride in the groundwater
- large scale hydraulic properties of the unsaturated zone
- assessment of the efficiency of vacuum extraction equipment at the principal carbon tetrachloride disposal sites.

The emphasis of the Phase I investigations is on cost efficiency, timeliness, and safety. For example, the Phase I investigations will use only existing structures (boreholes, piping, vents) to reduce costs, durations, and safety hazards associated with drilling and sampling in the radioactive soils beneath the three principal disposal sites. The analyses of soil gas and groundwater will be performed at EPA analytical Level II in the field using portable equipment to reduce costs and turnaround times.

A Phase II site evaluation will be conducted as required by the results of the Phase I site evaluation and remedial action. Additional tasks might include drilling and sampling one or more new wells (outside the zone of radioactively contaminated soils). The new wells would be placed to optimize vapor extraction.

4.1.1 Task 1 - Source Data Compilation and Review Task

This task will consist of compiling and evaluating existing information on carbon tetrachloride (and other) waste generation, storage, handling, and disposal. Information sources would include topographic maps, aerial photographs, engineering plans and drawings, Z Plant inventory and activity records, effluent discharge reports, and environmental release reports. This task will also include interviews with those having personal knowledge of past activities at the 200 West Area. Data evaluation will focus on exact locations and construction specifications of pertinent disposal facilities, their periods of operation and functional uses, and types and quantities of radiological or hazardous materials generated, used, and/or discharged.

4.1.2 Task 2 - Geologic/Geochemical Data Compilation and Review

This task will consist of compiling and evaluating existing data on regional (200 West Area) and site-specific geology and on soil contamination in the vicinity of the principal carbon tetrachloride disposal sites. This task will focus on collection of existing geologic literature, maps, borehole geologic and geophysical logs, surface radiation survey results, and soil contaminant distribution.

4.1.3 Task 3 - Hydrogeologic Data Compilation and Review

This task will consist of compiling and evaluating existing data on regional (200 West Area) and site-specific hydrogeology and on groundwater contamination. Information sources will include hydrogeologic and groundwater monitoring reports, existing monitoring well construction records, and groundwater quality data.

4.2 FIELD INVESTIGATION TASKS

4.2.1 Task 1 - Evaluation of Existing Wells

Task Objective: The purpose of this activity is to obtain information on the integrity and accessibility of, and depth of groundwater existing in boreholes located in the vicinity of the three carbon tetrachloride disposal sites for use during characterization activities (i.e., soil gas and groundwater sampling) and/or remedial actions (i.e., soil vacuum extraction).

Task Description: After the existing information on boreholes is collected and analyzed (as part of Section 4.1.1), wells will be visually inspected and sounded to determine the total depth and water level (if groundwater present). A television camera will be run on wells specified by the project scientist or project engineer.

Sampling Locations, Frequencies, and Analyses: No sampling is required under this task. Wells within approximately 100 ft of each of the three waste sites will be included in the evaluation. Other wells of interest will be included at the discretion of the project scientist or project engineer. All well locations not currently identified with Hanford Site coordinates and elevations will be surveyed (Task 3).

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4.2.2 Task 2 - Topographic Mapping

Task Objective: The objective of this task is to provide a base map that will be used to locate activities for characterization tasks. This task will be deleted at the discretion of the project scientist if sufficient existing data are found during data compilation (Section 4.1.1).

Task Description: Topographic maps for the three disposal sites will be mapped at a scale that will allow the precision needed to show elevation contours at 0.5-m intervals. Site features such as fencelines, gates, buildings, pipelines, and roads will be included. The site maps will extend 200 ft beyond the disposal sites.

Sampling Locations, Frequencies, and Analyses: No sampling is required under this task.

4.2.3 Task 3 - Locational Data Documentation

Task Objective: The objective of this activity is to document all Phase I field sampling locations.

Task Description: Locational data includes Hanford Site coordinates, elevations in feet (ft) above mean sea level, and depths of boreholes/probes below the surface. Table 1 identifies the locational data needed for specific sampling methods.

Table 1. Locational Data Types for Sampling Methods

Sampling Method	Locational Data Type
Soil Gas Probes	NS/EW Coordinates, Elevations, Depths
Existing Wells	NS/EW Coordinates, Elevations, Depths
Geophysical Transects	NS/EW Coordinates

Sample Locations, Frequencies, and Analyses: No sampling is required under this task.

4.2.4 Task 4 - Geophysical Survey

Task Objective: The objective of this activity is to determine the boundaries, depths of fill, and locations of buried objects at the three disposal sites. This task will be deleted at the discretion of the project scientist if sufficient existing data are found during data compilation (Section 4.1.1).

Task Description: The need for the implementation of this activity is contingent on the results of the source data compilation described in Section 4.1.1. If available information is insufficient, additional data will be acquired using ground-penetrating radar and/or electromagnetic induction.

Sampling Locations, Frequencies, and Analyses: At each disposal site, a grid sampling pattern will be established at a scale that will allow delineation of crib boundaries at the surface with a 3-ft resolution; fill depths and buried objects will be delineated within the upper 12 ft with a resolution of 1 ft. Two orthogonal lines across each crib will be surveyed for buried objects before the surface soil gas surveys are conducted (Task 5).

4.2.5 Task 5 - Soil Gas Surveys

4.2.5.1 Task 5A Surface Soil Gas Survey

Task Objective: The purpose of this activity is to map and verify the contaminant distribution of carbon tetrachloride in the vicinity of the three disposal sites.

Task Description: A soil gas survey will be conducted to determine the lateral distribution of carbon tetrachloride vapor and/or other soil gases beneath the three disposal sites.

Sample Locations, Frequencies, and Analyses: The surface soil gas survey at each of the three disposal sites will be conducted initially along two orthogonal grid lines which extend 100 ft in each direction beyond the crib boundaries. At each disposal site, approximately 30 to 50 soil gas probes will be installed at 20-ft intervals, where feasible. The sample spacing may be reduced by the field team leader or project scientist to define any contaminant gradients. Additional soil gas sampling may be conducted at the discretion of the project scientist. Soil gas concentrations will be analyzed using a portable gas chromatograph. Soil gas probe locations will be staked for surveying (see Task 3). Samples will be analyzed for volatile hydrocarbons. If feasible, installation will be permanent to allow resampling during later phases of the remediation.

4.2.5.2 Task 5B Soil Gas Surveys in Existing Wells

Task Objective: The purpose of this task initially is to determine if carbon tetrachloride and/or other gases are present in existing wells or structures (i.e., vents, crib piping) at the three disposal sites and then, if feasible, to determine the vertical distribution of the carbon tetrachloride and/or other gases. The data will also be used to estimate large scale hydraulic properties required in the modeling effort.

Task Description: During the first phase, samples of the undisturbed gases will be collected from the bottom of boreholes near each disposal site. This activity will be conducted in conjunction with Task 1. The samples will preferably be collected during falling (or rising) barometric pressure. Samples will be collected using explosion-proof solenoid valve collection devices and analyzed with a portable gas chromatograph.

The second phase of this task will consist of sampling an existing well(s) (as chosen by the project scientist and project engineer) at one of the three disposal sites using a vacuum pump. This test will be conducted in conjunction with Task 7 when appropriate. Sampling will be conducted using straddle packers to isolate screened sections of a well. Further testing may be conducted (at the direction of the project scientist or project engineer) by perforating the well casing to expose additional intervals. Before perforating the casing in wells within or near the three disposal sites, a spectral gamma logging tool will be run down the well to identify zones of radioactively contaminated soils. Casing in radioactively contaminated zones will not be perforated, unless specified by the project scientist or project engineer. If feasible, installations will be permanent to allow observations during nearby tests and resampling during a later phase of the remediation.

A pressure transducer will be placed in the borehole at the open interval to record the downhole pressure at 10-s intervals. The flow meter on the vacuum pump will also provide data at 10-s intervals. If feasible, data will be collected at several different flow rates (Task 7). Pressure transducers will be placed at several isolated intervals in a nearby observation well(s); a barometric pressure recorder will be placed at or near the surface of the observation well(s). This information will be used to estimate the large scale hydraulic conductivities of the unsaturated sediments for soil gas (Sisson and Ellis 1990).

Sampling Locations, Frequencies, and Analyses: During the first phase, all wells which are to be evaluated during Task 1 will also be sampled unless otherwise directed by project scientist or field team leader. Each well will be sampled once. Crib structures will be sampled at the discretion of the project scientist or field team leader.

During the second phase of this task, the wells and/or structures to be sampled will be chosen by the project scientist and project engineer based on the results of the undisturbed sample results (first phase), the well evaluation study (Task 1), and the vacuum pump requirements (Task 7). Multiple samples will be collected during the vacuum pump test.

Soil gas will be analyzed for volatile aromatic and halogenated hydrocarbons using a portable gas chromatograph.

4.2.6 Task 6 - Groundwater Sampling

Task Objective: The purpose of this activity is to sample and analyze existing monitoring wells in and around the three disposal sites and at other locations pertinent to the IRA. Data will be used to assess the distribution of the carbon tetrachloride in groundwater and to identify wells which can be used to monitor the success of the IRA.

Task Description: Groundwater samples will be obtained from existing wells. If necessary, sampling pumps will be installed. The data will be integrated with results from the ongoing Hanford Site groundwater monitoring programs.

Sample Locations, Frequencies, and Analyses: Groundwater samples will be collected from approximately 16 wells. The initial list (Table 2) was chosen based on well location, well construction, screened intervals, and carbon tetrachloride concentration history. Wells may be added or subtracted from the initial sampling network at the discretion of the project scientist or field team leader. Sampling during this phase will occur at least once. The samples will be analyzed with portable field screening equipment (gas chromatograph). Sampling and analysis of groundwater during and after remediation will be conducted under the monitoring program set forth in the Operations and Maintenance Plan (see Chapter 6.0).

Table 2 Groundwater Wells to be Sampled

Well	Purpose/Location
299-W18-7*	216-Z-1A Tile Field
299-W18-9	216-Z-18 Crib
299-W18-10	216-Z-18 Crib
299-W18-11	216-Z-18 Crib
299-W18-12	216-Z-18 Crib
299-W15-6	216-Z-9 Trench
299-W15-8	216-Z-9 Trench
299-W15-9	216-Z-9 Trench
299-W15-16	Maximum observed concentrations
699-39-79	Increasing concentrations near maximum of plume
699-38-70	Eastern perimeter of plume
699-49-79	Northern perimeter of plume
699-43-88	Western perimeter of plume
299-W18-20	Southern perimeter of plume
299-W18-17	Southern perimeter of plume
299-W18-18	Southern perimeter of plume

*Note: Well 299-W18-6 at the 216-Z-1A Tile Field is believed to be collapsed and dry.

4.2.7 Task 7 - Vacuum Extraction Test

Task Objective: The purpose of this activity is to obtain information on: (1) the volume and types of contaminants that can be extracted from existing wells; (2) information on trends in concentration of contaminants extracted over time; and (3) information on the zone of influence using the existing wells for gas extraction. This activity will be conducted to provide information that may be useful in design and evaluation of remedial technologies.

Task Description: At one of the three principal carbon tetrachloride disposal sites (to be determined by the project scientist and project engineer), one well will be used as a gas extraction well while another well(s) will be used as an observation well(s). The extraction well shall be pumped for a period of approximately 1 wk (or longer at the discretion of the project scientist or project engineer) to characterize the volume and nature of contaminants that can be extracted.

Air pressure in the observation well shall be monitored during pumping to determine whether it is within the zone of influence of the extraction well. If the observation well is within the zone of influence, at the option of the project scientist or project engineer, a tracer gas will be injected

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into it to determine the travel time and source strength required to detect it in the extraction well.

A calibrated flowmeter shall continuously monitor the volume of vapor removed from the well and a vacuum gauge will monitor and control the vacuum applied to the well to maintain it at a steady pressure.

A test plan will be prepared prior to the conduct of this test.

Sampling Locations, Frequencies, and Analyses: The identity of pumping and monitoring well(s) will be determined after the well evaluation task (see Task 1). During the first week of pumping, soil gas samples shall be collected from the extraction air stream at the following frequencies:

- Hourly for the first 4 hr of pumping
- Every 4 hr for the next 20 hr of pumping
- Every 6 hr for the next 24 hr of pumping
- Every 12 hr for the next 5 d.

Sampling shall be conducted at the frequencies noted above, unless results of that sampling indicate modifications to the schedule are warranted.

Samples will be analyzed onsite for volatile aromatic and halogenated hydrocarbons using a portable gas chromatograph equipped with an electron capture detector and a photoionization detector. Further details will be found in the test plan.

4.3 DATA EVALUATION

4.3.1 Task 1 - Data Integration

The results from the Phase I Site Evaluation will be compiled and integrated with existing data (Section 4.1.1). Data and interpretations will be displayed in cross sections and/or maps that illustrate contaminant distribution, site physical characteristics, geology, and hydrogeology.

4.3.1 Task 2 - Modeling

Task Objective: A modeling process will be employed to provide estimates of the extent of contamination and of concentration of carbon tetrachloride vapors and to guide the remediation activities. The modeling process includes the use of field sampling results.

Task Description: Information collected in Section 4.1, "Data Compilation and Review Tasks", Task 1, "Source Data Compilation and Review Task" will form the basis of definition of the source term, which is basic to the modeling process.

The other fundamental aspect of the modeling process is the development of a conceptual model of the subsurface environment, and this will be based on Task 2, "Geologic/Geochemical Data Compilation and Review" of Section 4.1.

The modeling process will be accomplished by dealing with the source term in several steps to ascertain the importance of the several phases of the carbon tetrachloride and how each interacts with the subsurface environment. Much of the modeling activity will be based on work performed at the Idaho National Engineering Laboratory by EG&G (Sisson and Ellis 1990).

The primary model for use in this project is PORFLO, which has been applied on several Hanford Site projects. This code deals with two-dimensional flow and transport (and has the option of three-dimensional flow and transport, if necessary) in the vadose zone and groundwater. It also has the capability of dealing with heat flow and, with some modification, two-phase flow, if these conditions are appropriate and feasible in the limited time available.

Data collected under the field activities of Section 4.2 will be used to assist in model calibration and refinement of the conceptual model.

Sampling Locations, Frequencies, and Analyses: No sampling is required under this task.

5.0 IRA PROPOSAL AND ACTION MEMORANDUM

The purpose of the IRA proposal is to provide the EPA, Ecology, and the public with information that (1) defines the origin, nature, and extent of contamination at the site; (2) characterizes the hydrogeologic regime; (3) assesses public health and environmental risk; (4) evaluates viable remedial technologies; and (5) recommends remedial actions. This report will be completed following the completion of the site evaluation tasks (see Chapter 4.0).

If an IRA is warranted, an evaluation of remedial technologies must be conducted. This step involves a rapid, focused engineering evaluation/cost assessment, using specific screening factors and selection criteria to assess the feasibility, appropriateness, and costs of available technologies. The IRA proposal, which contains the engineering evaluation/cost assessment, will undergo a concurrent DOE, EPA, and Ecology review. In addition, the public will have a 30-day period to comment on the document.

Upon reviewing the IRA proposal, the EPA will issue an IRA action memorandum. The action memorandum serves as the primary decision document substantiating the need for a removal response and documents EPA's selection of the remedial action.

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6.0 IRA DESIGN AND IMPLEMENTATION

Following the decision of the EPA to conduct a specific remedial action at the carbon tetrachloride disposal sites through the action memorandum (see Chapter 5.0), the remedial action will be designed and implemented. Details of the design and implementation strategy will be documented in design plans before the implementation of the remedial action. Many of the initial design input parameters will be collected during site evaluation (see Chapter 4.0). In addition, an operation and maintenance plan will be prepared prior to initiating the remedial action.

If a soil vapor extraction system is used in the remedial action, as suggested by EPA and Ecology guidance (see Exhibit 1), a phased strategy of implementation will be used:

- Phase I - Initiate organic vapor extraction (and treatment) using existing wells as air injection and/or vapor withdrawal wells at one or two of the principal carbon tetrachloride disposal sites. Certain wells may require structural modification.

- Phase II - Deepen wells and/or install new wells to increase the organic removal efficiency of the vapor extraction system. Expand the remedial action to include the remaining principal carbon tetrachloride disposal site(s) or other candidate sites identified during site evaluation.

A Phase II implementation, under this scenario, would not be initiated without concurrence by the EPA and Ecology. Results from a Phase I remedial action (i.e., recovery efficiency and other process design data) will be used as design input in subsequent design processes for Phase II remedial action.

7.0 PROJECT SCHEDULE

The anticipated schedule for completing the 200 West Area Carbon Tetrachloride IRA is presented in Figure 7-1. The following key assumptions were used in the development of this schedule:

- The schedule is for the Phase I site evaluation and remediation.
- Site evaluation tasks will primarily consist of nonintrusive investigative activities (no drilling).
- Existing well conditions will not prohibit use of certain wells (or a sufficient number thereof) in the remedial action.
- The schedule will not be impacted by the conduct of a safety analysis (DOE Order 5481.18)
- The IRA Proposal is concurrently reviewed by DOE, EPA, and Ecology; the public will have a 30-day period to comment on the IRA proposal.
- A form of soil vapor extraction with some form of aboveground treatment will be used for the remedial action.
- The remediation facilities can be constructed and brought on-line from "off-the-shelf" components.
- Facilities will not be subject to NQA-1 nuclear design requirements.

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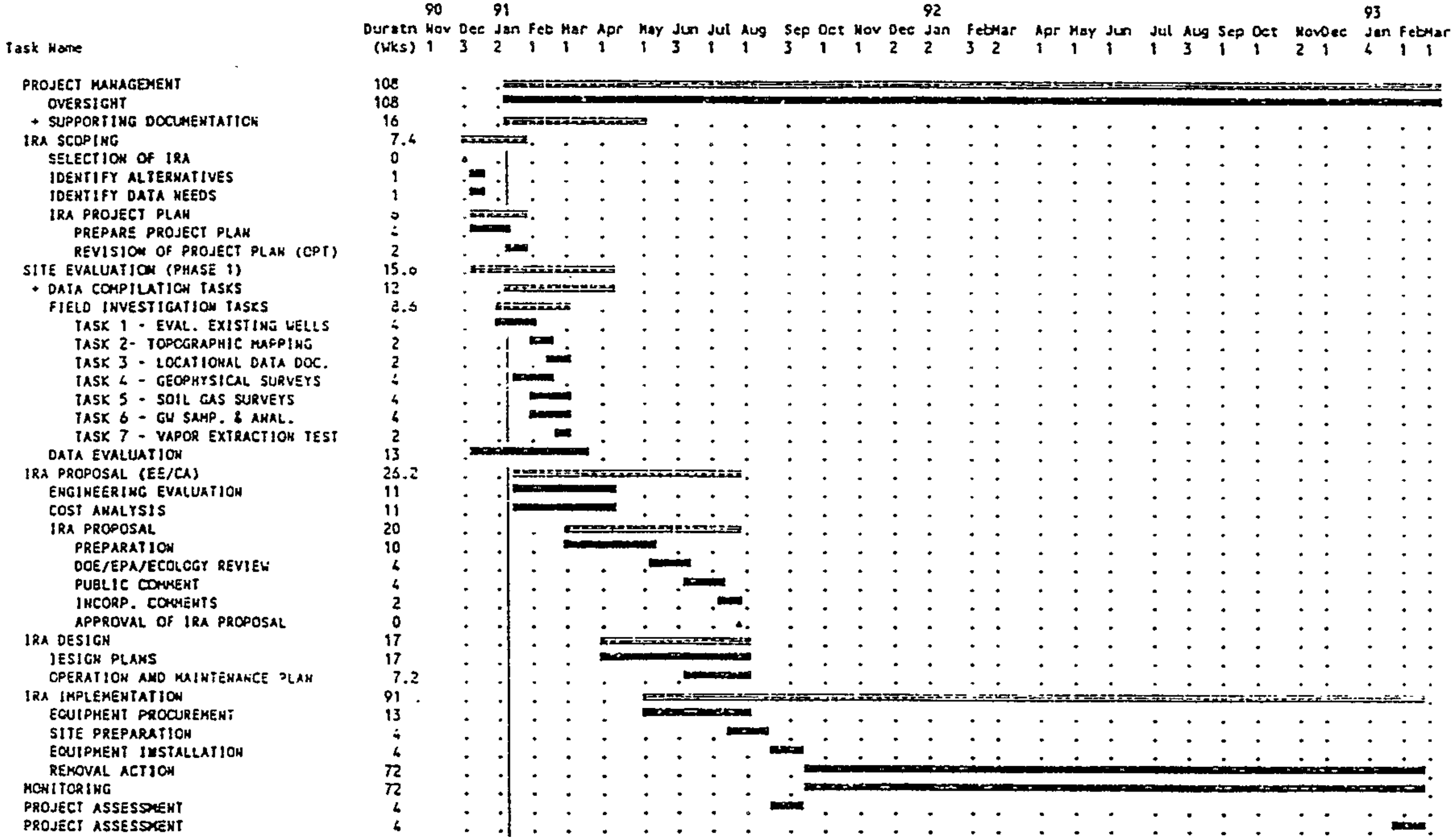

Figure 7-1. Phase I 200 West Area Carbon Tetrachloride IRA.

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ATTACHMENT 1

SAMPLING AND ANALYSIS PLAN

PART 1 - FIELD SAMPLING PLAN (see Chapter 4.0)

PART 2 - QUALITY ASSURANCE PROJECT PLAN (Phase I Site Evaluation)

QUALITY ASSURANCE PROJECT PLAN
Phase I Site Evaluation

PROJECT DESCRIPTION

The primary objective of the 200 West Area Carbon Tetrachloride Interim Response Action (IRA) is to remediate carbon tetrachloride vapors in the unsaturated sediments in the 200 West Area. The focus of the Phase I Site Evaluation effort will be on the three liquid waste disposal sites associated with Z Plant which received the bulk of the carbon tetrachloride in the 200 West Area: (1) the 216-Z-1A Tile Field, (2) the 216-Z-9 Trench, and (3) the 216-Z-18 Crib. The descriptions of the physical characteristics of the IRA site, nature, and extent of contamination are included in Section 2.0, Site Characteristics. Specific project objectives for the field investigation tasks of the Phase I Site Evaluation are outlined in Section 4.2.1.

PROJECT ORGANIZATION AND RESPONSIBILITIES

Key personnel and organizations necessary for IRA activities are outlined in the Attachment 3, Project Management Plan (PMP). The PMP includes a chart indicating organization and line of authority.

QUALITY ASSURANCE (QA) OBJECTIVES FOR MEASUREMENT

Samples will be analyzed at Environmental Protection Agency Level II with a portable gas chromatograph. Field screening with a calibrated instrument is adequate for determining concentrations, and the results are required in real-time. Accuracy, precision, and detection limits of the instrument will be determined during field calibration.

PROCEDURES

The Westinghouse Hanford Company (Westinghouse Hanford) procedures that will be used to support the sampling plan have been selected from the Environmental Engineering, Technology and Permitting function's *Quality Assurance Program Plan* (WHC 1990), which will be included in the Westinghouse Hanford QA program plan for *Comprehensive Environmental Response, Compensation, and Liability Act* Remedial Investigation/Feasibility Study activities. Selected procedures include Environmental Investigations Instructions (EIIs) from the *Environmental Investigations and Site Characterization Manual* (WHC 1989b), and Quality Requirements and Quality Instructions, from the *Westinghouse Hanford Quality Assurance Manual* (WHC 1988a)

The tasks of the Phase I Site Evaluation are discussed in Section 4.2, Field Investigation Tasks, and are listed in Table 1 for easy reference. The EII *Environmental Investigations and Site Characterization Manual* (WHC 1989) which govern these tasks are listed in Table 2. Details on the surveying equipment and procedures (Tasks 2 and 3) will be specified in approved participant contractor procedures; EII 12.1, Surveying. Procedures for Soil Gas Analysis (Task 5) and Groundwater Analysis (Task 6) using a portable GC are in preparation. Procedures governing the Vacuum Extraction Test (Task 7) are in preparation.

Table 1. Field Investigation Tasks.

Number	Title
Task 1	Evaluation of Existing Wells
Task 2	Topographic Mapping
Task 3	Locational Data Documentation
Task 4	Geophysical Survey
Task 5	Soil Gas Surveys
Task 6	Groundwater Sampling
Task 7	Vacuum Extraction Test

Table 2. Procedures for Field Investigation Tasks.

Procedure	Task 1	2	3	4	5	6	7
EII 1.5 Field Logbooks	X	X	X	X	X	X	X
EII 5.8 Groundwater Sampling						X	
EII 5.9 Soil-Gas Sampling			X		X		
EII 6.6 Well Characterization		X	X				
EII 11.2 Geophysical Survey Work				X	X		

Procedural approval, revision, and distribution control requirements applicable to EIIs are addressed in EII 1.2, Preparation and Revision of Environmental Investigations Instructions. Deviations from established EIIs that may be required in response to unforseen field situations may be authorized in compliance with EII 1.4, Deviation from Environmental Investigations Instructions.

Sampling locations, frequencies, and analyses are described in Section 4.2.

SAMPLE CUSTODY

Sample custody will be maintained as appropriate if sample analysis does not immediately follow sample collection. Results of analyses shall be traceable to original samples through the unique code or identifier assigned to the sample in the field. Results of field investigations will be controlled according to Attachment 4, Data Management Plan.

CALIBRATION PROCEDURES

Calibration of measuring equipment will be done according to procedures governing its use. Calibration of Westinghouse Hanford, participant contractor, or subcontractor analytical equipment shall be as defined by applicable standard analytical methods, subject to Westinghouse Hanford review and approval.

ANALYTICAL PROCEDURES

Analytical methods are identified in Section 4.2, Field Investigation Tasks. Procedures based on these methods will be selected or developed and approved prior to use in compliance with appropriate Westinghouse Hanford procedure and/or procurement control requirements.

DATA REDUCTION, VALIDATION, AND REPORTING

The Field Team Leader for each task will be responsible for preparing a report summarizing the results of analysis and for preparing a detailed data package that includes all information necessary to perform data validation as required. As a minimum, data packages will include:

- Sample documentation, including identification of the organizations and individuals performing the extraction and analysis; the signatures of the responsible extractor and analyst; documentation of any sample custody; and the dates of sample extraction and analysis.

- Instrument calibration documentation, including equipment type and model, for the time period in which the sample analysis was performed.

- Quality control data, as appropriate for the methods used.

- Analytical results or data deliverables, including reduced data, reduction formulae or algorithms, and identification of data outliers or deficiencies.

INTERNAL QUALITY CONTROL

Internal quality control methods, such as the use of field duplicate samples and field blanks, will be used as appropriate.

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PERFORMANCE AND SYSTEMS AUDITS

Audits in environmental investigations are considered to be systematic checks that verify the quality of operation of one or more elements of the total measurement system. Performance audit requirements will be met by the use of internal quality control methods, as appropriate. Systems audits will be scheduled if so requested by the project lead, project scientist, or U.S. Department of Energy-Richland Operations Office (DOE-RL).

PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field that directly affects the quality of the analytical data shall be subject to preventive maintenance measurements that ensure minimization of measurement system downtime. Field equipment maintenance instructions shall be as defined by the approved procedures governing their use.

DATA ASSESSMENT PROCEDURES

Measurement data will be assessed for qualities such as precision and accuracy by the Field Team Leader responsible for that measurement.

CORRECTIVE ACTIONS

In the context of quality assurance (QA), corrective actions are procedures that might be implemented on samples that do not meet QA specifications. A corrective action request might be generated, for example, by an audit. Corrective actions may include resampling or reanalyzing samples, if feasible. The primary responsibility for corrective action resolution is assigned to the project scientist and project lead.

QUALITY ASSURANCE REPORT

Copies of all QA documentation, such as audits and corrective action resolutions, will be routed to the project QA records upon completion of the sampling and analysis activities. The final project report will summarize the data quality information related to the field investigation activities.

ATTACHMENT 2

HEALTH AND SAFETY PLAN

The work plan level Health and Safety Plan (HSP) addresses potential health and safety issues associated with characterization and remediation during the 200 West Area Carbon Tetrachloride Interim Remedial Action (IRA) project. The HSP consists of the site description and discussion of the types/sources of contamination based on all available information. Site/task-specific hazards, per 29 CFR 1910.120 and environmental investigation instructions (EII) 2.1 (WHC 1988), will be detailed in site/task-specific Preparation of Hazardous Waste Operations Permits.

SITE DESCRIPTION

The 200 West Area IRA focuses on three retired liquid waste disposal facilities associated with Z Plant plutonium recovery processes: (1) the 216-Z-1A Tile Field, (2) the 216-Z-9 Trench, and (3) the 216-Z-18 Crib. The IRA activities include use of existing structures (e.g., boreholes, vents, and piping) located within these facilities. These three cribs received the bulk of the carbon tetrachloride disposed to the ground between 1955 and 1973, when soil column disposal of carbon tetrachloride associated with Z Plant processes ceased. Locations and descriptions of the cribs are included in Section 2.1.1, Liquid Waste Disposal Facilities.

TYPES/SOURCES OF CONTAMINATION

The three principal carbon tetrachloride disposal sites received acidic and organic, actinide-bearing liquid wastes (Section 2.2.1). Based on existing information, the contaminants discharged to the cribs are both chemical and radiological.

Aqueous solutions discharged to the three principal carbon tetrachloride cribs were concentrated, acidic, metal nitrate salt wastes (Section 2.2.1). Organic material, including carbon tetrachloride, tributyl phosphate, and dibutylbutylphosphonate, and fabrication oil, were disposed in saturation amounts in the aqueous solution and also separately in batches. Carbon tetrachloride degradation products such as chloroform and methylene chloride are also likely. An 0.07 M solution of cadmium nitrate (a total of 11 kg of cadmium) was later sprayed on the soil at 216-Z-9 Trench.

The principal radiological contaminants in the vadose zone underlying the three cribs are plutonium-239/240 and americium-240. Minor amounts of cesium-137 and strontium-90 are also indicated in the Waste Information Data System database for the 216-Z-9 Trench and 216-Z-1A Tile Field. Routine surface radiation surveillances are conducted at these cribs, and no problems have been identified. The radiological hazards associated with IRA activities will be controlled by radiation work permits.

Groundwater contaminants identified in the 200 West Area include carbon tetrachloride, chloroform, cyanide, fluoride, hexavalent chromium, trichloroethylene, nitrate, strontium-90, tritium, technetium-99, iodine-129, and uranium (Section 2.2.2).

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ATTACHMENT 3

PROJECT MANAGEMENT PLAN

The purpose of the project management plan (PMP) is to define the administrative and institutional tasks necessary to support the 200 West Area Carbon Tetrachloride Interim Response Action (IRA) within the 200-ZP-1 and 200-ZP-2 operable units. The PMP defines the responsibilities of the various participants, organizational structure, project tracking, and reporting.

PROJECT ORGANIZATION AND RESPONSIBILITIES

INTERFACES

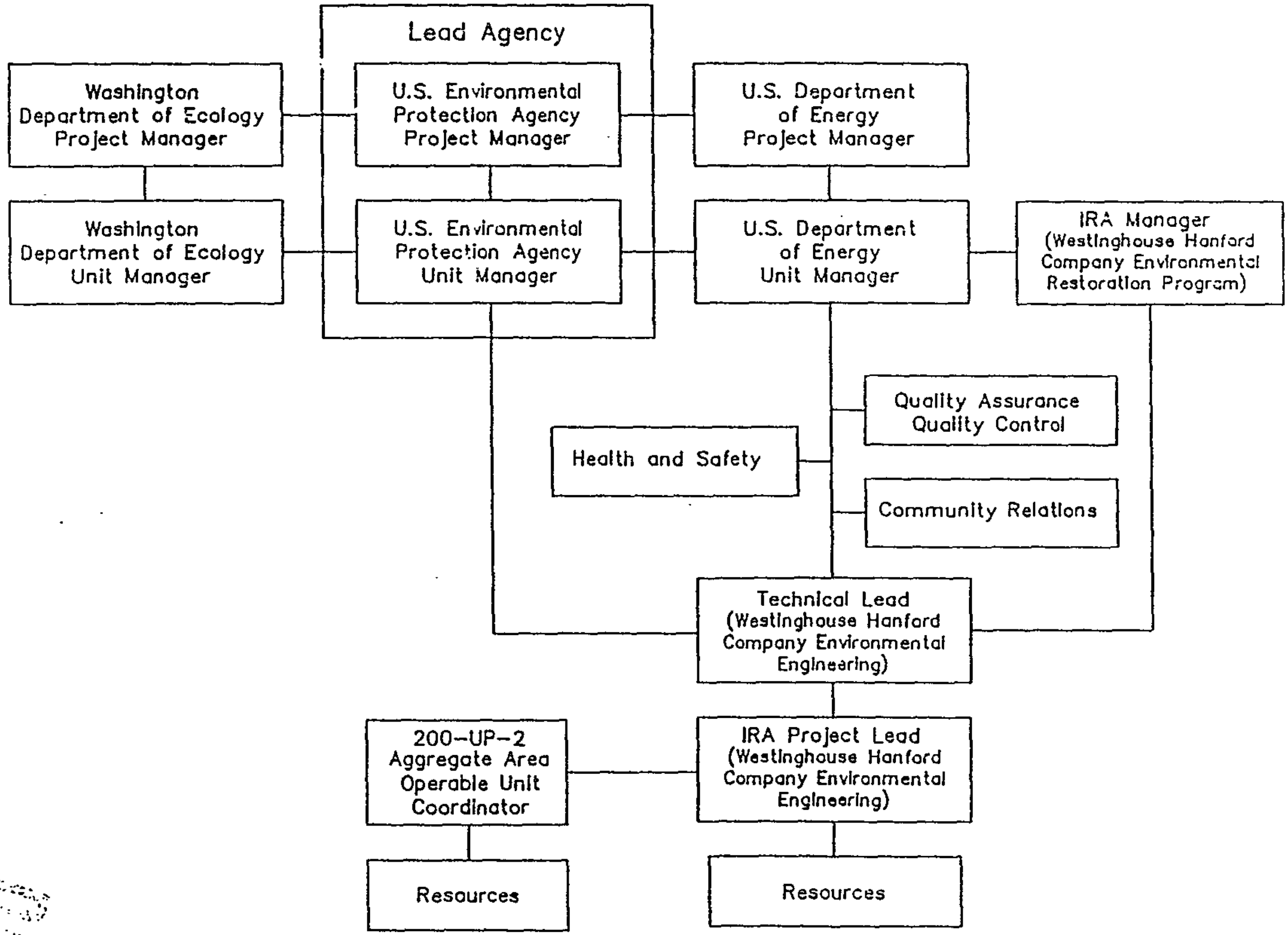
Figure 1 shows the U.S. Environmental Protection Agency (EPA), Washington Department of Ecology (Ecology), U.S. Department of Energy (DOE), and Westinghouse Hanford Company (Westinghouse Hanford) organizational interfaces for the IRA. The IRA is conducted under the lead of the EPA per the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989). The specific responsibilities of EPA, Ecology, and the DOE are detailed in the Action Plan (Attachment 2 of the Tri-Party Agreement). Westinghouse Hanford Environmental Engineering is the technical lead for the 200 Area operable units and any remedial actions. The IRA is to be conducted on inactive disposal sites located within the 200-ZP-1 and 200-ZP-2 operable units. Remedial investigations have not yet been initiated within these operable units; however, an aggregate study of the 200 West Area has been proposed to be conducted concurrently with the IRA. A Westinghouse Hanford technical coordinator has been assigned to this project and will interface with the IRA technical lead.

PRINCIPAL ORGANIZATIONS

The IRA will be conducted under the lead of the Westinghouse Hanford Environmental Division. Three groups within the Environmental Division will provide project management to accomplish the major elements of the IRA (Figure 2), they are as follows:

Environmental Engineering Group (EEG)--The EEG provides a project management lead and coordinates technical resources for the IRA. The EEG also provides a project engineering lead to conduct the IRA design. In addition, the EEG supports the IRA site evaluation activities by conducting certain field and data evaluation tasks (i.e., soil gas surveys).

Geosciences Group (GG)--The GG provides a project scientist to conduct the IRA site evaluation tasks. The project scientist also provides support to the project lead, project engineer, and operations manager during the IRA design and implementation.


Lead Agency
Washington Department of Ecology Project Manager
U.S. Environmental Protection Agency Project Manager
U.S. Department of Energy Project Manager
Washington Department of Ecology Unit Manager
U.S. Environmental Protection Agency Unit Manager
U.S. Department of Energy Unit Manager
IRA Manager (Westinghouse Hanford Company Environmental Restoration Program)
Quality Assurance Quality Control
Health and Safety
Community Relations
Technical Lead (Westinghouse Hanford Company Environmental Engineering)
200-UP-2 Aggregate Area Operable Unit Coordinator
IRA Project Lead (Westinghouse Hanford Company Environmental Engineering)
Resources
Resources

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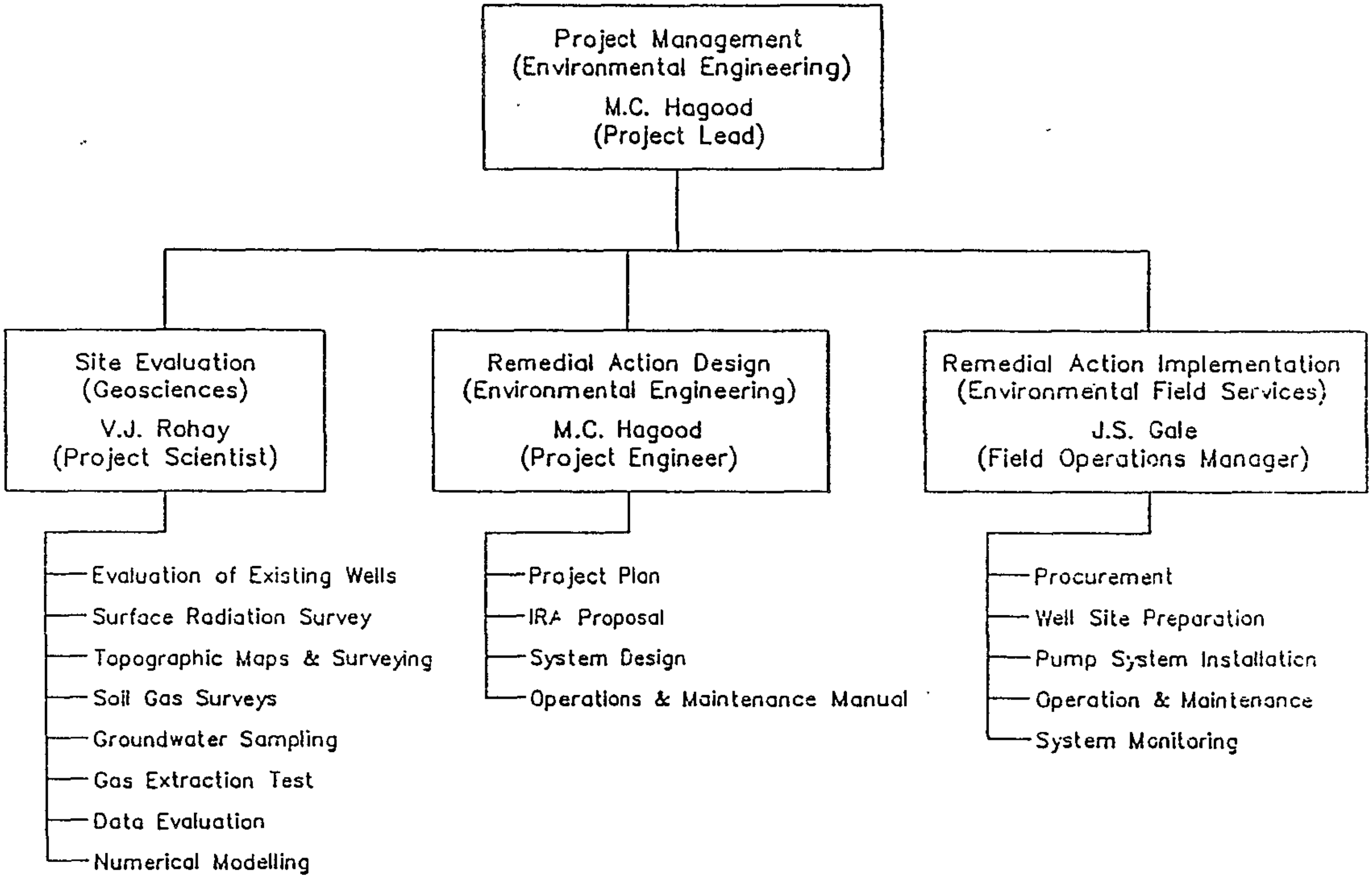
200-West Carbon Tetrachloride IRA Organization



PMP-3

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Environmental Field Services (EFS)--The EFS provides a field operations manager to implement the IRA. The EFS also provides field support and technical review support to conduct IRA site characterization and design tasks. In addition, EFS prepares and provides approved industrial health and safety documents and a site safety officer to oversee health monitoring activities.

OTHER SUPPORT ORGANIZATIONS

Other organizations within and outside the Environmental Division provide support to the IRA project. The organizations and services are described below.

- National Environmental Policy Act (NEPA) Documentation--Ensures the necessary documentation for NEPA and State Environmental Policy Act for the IRA are approved and in place.
- Regulatory Analysis--Provides information and regulatory guidance on environmental regulations (i.e., air permitting).
- Industrial Safety and Fire Protection (IS&FP)--Ensures applicable health and safety requirements are appropriately addressed and provides a letter report summarizing IS&FP activities during IRA activities.
- Quality Assurance--Ensures appropriate quality assurance requirements are addressed and conducts surveillance of the IRA as necessary.
- Environmental Protection--Ensures compliance with environmental regulations and Hanford Site requirements.
- Health Physics--Prepares and issues the necessary Radiation Work Permit and provides necessary Health Physics technician support during removal and related activities.
- Cultural Resources (Pacific Northwest Laboratory)--Provides archaeological documentation and support as necessary.
- Facility Safety--Prepares and issues required facility safety documents(s).
- Inactive Facilities Surveillance and Maintenance--Provides nuclear process operators and decontamination and decommissioning workers as needed to support IRA activities.

DOCUMENTATION AND RECORDS

An IRA proposal will be prepared by Westinghouse Hanford as a primary document and reviewed by the U.S. Department of Energy-Richland Operations Office (DOE-RL), EPA, Ecology, and the public. The comments received will be resolved prior to the EPA issuing an action memorandum which officially documents their approval of the proposed activities.

All other records and reports related to the IRA will be considered secondary documents and will be included in the project records to be maintained by the project lead in accordance with environmental investigations instruction (EII) 1.6, Records Management (WHC 1988). Appropriate records will also be incorporated into an official administrative record file, which will be made available for public review.

FINANCIAL AND PROJECT TRACKING REQUIREMENTS

The Westinghouse Hanford EEG will have overall responsibility for planning and controlling the IRA activities, providing effective technical, cost, and schedule baseline management. The management control system used for this project must meet the requirements of DOE Order 4700.1, Project Management System (DOE 1987), DOE Order 2250.1B, Cost and Schedule Control, and Systems Criteria for Contract Performance Measurement (DOE 1985). The Westinghouse Hanford Management Control System (MCS) meets these requirements. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The IRA schedule and major milestones are presented in Section 7.0. The schedule will be the primary guidance for the regulators, DOE, and the technical lead to track the progress of the IRA.

MEETINGS AND PROGRESS REPORTS

The regulators, DOE, and Westinghouse Hanford participate in open discussions during weekly meetings to resolve issues related to the status of the IRA. These meetings provide a continuing dialogue with the regulators. The status of the IRA will be presented at ongoing unit managers meetings concerning the IRA. In Addition, a progress report will be prepared and submitted to the EPA, DOE-RL, and DOE at the end of each fiscal year.

REFERENCES

DOE, 1985, *Cost and Schedule Control Systems Criteria for Contract Performance Measurement*, DOE Order 2250.1B, U.S. Department of Energy, Washington, D.C.

DOE, 1987, *Project Management System*, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.

Ecology et al. 1989, *Hanford Federal Facility Agreement and Consent Order*, Washington Department of Ecology, U.S. Environmental Protection Agency, and Department of Energy, Olympia, Washington.

WHC, 1988, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT 4

DATA MANAGEMENT PLAN

INTRODUCTION

This data management plan (DMP) addresses management of data generated from the 200 West Area Carbon Tetrachloride Interim Response Action (IRA) project activities.

A considerable amount of data will be generated through the implementation of the IRA project plan and attachments. The quality assurance project plan (QAPP) provides the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to ensure quality data results. Chapter 4.0 provides the detailed logistical methods to be employed in selecting the location, depth, frequency of collection, etc., of media to be sampled and the methods to be employed to obtain samples of the selected media for cataloging and analysis.

Development of a comprehensive plan for the management of all environmental data generated at the Hanford Site is under way. The *Environmental Information Management Plan* (EIMP) (Steward 1989), released in March 1989, describes activities in the Environmental Data Management Center (EDMC) and provides a description of the long-range goals for management of scientific and technical data.

The Project Lead is responsible for maintaining and transmitting data to the designated storage facility.

TYPES OF DATA

SITE EVALUATION DATA

General data types generated by Phase I site evaluation tasks (Chapter 4.0) include field logbooks, screening data, verified sample analyses, historic data, quality assurance/quality control data, reports, memoranda/meeting minutes, telephone conversations, raw sample data, videotapes, magnetic media and supporting documentation, and chart recordings. Collection and handling of these data are governed by environmental investigations instruction (EII) 1.6, Records Management (WHC 1988), and those task-related procedures listed in the QAPP. The data will be stored in project files or in the EDMC, as appropriate.

The EDMC is the Westinghouse Hanford Environmental Division's central facility that provides a file management system for processing environmental information. All data entering the EDMC is indexed, recorded, and placed into safe and secure storage. The EDMC manages and controls the administrative record and the Administrative Record Public Access Room. The administrative

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record provides an index and key information on all data transmitted to the EDMC. Data designated for placement into the administrative record will be copied, placed into the Hanford Site Administrative Record File, and distributed by the EDMC to the user community.

Data transmittal to the EDMC is governed by the following procedures:

- EII 1.6, Records Management (WHC 1988)
- TPA-AP-06-R0, Predecisional Draft, "Clearance and Release of Administrative Record Documentation" (DOE-RL et al. 1990a)
- TPA-AP-07-R0, Predecisional Draft, "Information Transmittals and Receipt Control" (DOE-RL et al. 1990b)
- TPA-AP-10-R0, "Administrative Record Management" (DOE-RL et al. 1990c)
- WHC-EP-0219, *Environmental Information Management Plan* (Steward 1989).

Information Resource Management is the designated records custodian (permanent storage) for Westinghouse Hanford.

The Pacific Northwest Laboratory (PNL) operates the Hanford Meteorological Station that collects and maintains meteorological data. This database contains meteorological data dating from 1943 to present. Data management is discussed in the Hanford Meteorological Data Collection System and Data Base (Andrews 1988).

ADMINISTRATIVE DATA

Related administrative data include personnel training records, exposure records, respiratory protection fitting records, personnel health and safety records, and compliance and regulatory data.

The Hanford Environmental Health Foundation (HEHF) performs the analyses on the nonradiological health and exposure data and forwards summary reports to the Fire and Protection Group and the Environmental Health and Pesticide Services Section within the Westinghouse Hanford Environmental Division. Nonradiological and health exposure data are maintained also for other site contractors who may be involved in IRA activities. The HEHF provides summary data to the appropriate site contractor. HEHF also maintains personal health and safety records. The preparation of health and safety plans and the resulting data records are addressed in EII 2.1, Preparation of Hazardous Waste Operations Permits (WHC 1988) and occupational health monitoring is covered in EII 2.2, Occupational Health Monitoring (WHC 1988).

The Westinghouse Hanford EHPSS maintains personal protection equipment fitting records and maintains nonradiological health field exposure and exposure summary reports provided by HEHF for Westinghouse Hanford Environmental Division and subcontractor personnel.

Training records for Westinghouse Hanford and subcontractor personnel are managed by the Westinghouse Hanford Technical Training Support Section. Other Hanford Site contractors (PNL and KEH) maintain their own personnel training records.

The PNL collects and maintains data on occupational radiation exposure. This database contains respiratory personnel protection equipment fitting records, work restrictions, and radiation exposure information. Data management is discussed in the Hanford Meteorological Data Collection System and Data Base (Andrews 1988).

Compliance and regulatory data is maintained by the EMOC. Procedures governing data transmittal are listed in DMP Section 2.1

DATA QUANTITY

Data quantities are described in the project plan and the FSP.

ENVIRONMENTAL INFORMATION MANAGEMENT PLAN

The EIMP (Steward 1989) was issued is March 1989 and is currently under review. The first part of the EIMP provides an overview of the Westinghouse Hanford Environmental Division's working files management system and addresses the management of information transmitted to the EDMC, the Environmental Division's designated file manager, in support of Environmental Restoration Program activities. An overview is presented of the EDMC's location, operating mechanics, field file support services, automated support services, and the composition and compilation of an agency-required Administrative Record.

The second part of the EIMP addresses future plans for management of scientific and technical data. The planning and control activities affecting data are discussed. These activities include data collection, analysis, integration, transfer, storage, retrieval, and presentation.

REFERENCES

Andrews, G.L. (1988), *Hanford Meteorological Data Collection System and Data Base*, PNL-6509, Pacific Northwest Laboratory, Richland, Washington.

DOE-RL, EPA, and Ecology (1990a), *Clearance and Release of Administrative Record Documentation*, Predecisional Draft, TPA-AP-06-R0, U.S. Department of Energy-Richland Operations Office, U.S. Environmental Protection Agency, and Washington State Department of Ecology, Richland, Washington.

DOE-RL, EPA, and Ecology (1990b), *Information Transmittals and Receipt Control*, Predecisional Draft, TPA-AP-07-R0, U.S. Department of Energy-Richland Operations Office, U.S. Environmental Protectional Agency, and Washington State Department of Ecology, Richland, Washington.

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DOE-RL, EPA, and Ecology (1990c), *Administrative Record Management*, Predecisional Draft, TPA-AP-10-R0, U.S. Department of Energy-Richland Operations office, U.S. Environmental Protection Agency, and Washington State Department of Ecology, Richland, Washington.

Steward, J.C. (1989), *Environmental Information Management Plan*, WHC-EP-0219, Westinghouse Hanford Company, Richland, Washington.

WHC (1988), *Environmental Investigations and Site Characterizations Manual*, WHC-CM-7-7, Richland, Washington.

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ATTACHMENT 5

COMMUNITY RELATIONS PLAN

A Community Relations Plan (CRP) has been developed for the Hanford Site Environmental Restoration Program and is applicable to the 200 West Area Carbon Tetrachloride Interim Response Action (IRA). The CRP provides continuity and general coordination of all the Environmental Restoration Program activities with regard to community involvement. The site-wide CRP discusses Hanford Site background information, history of community involvement at the Hanford Site, and community concerns regarding the Hanford Site. It also delineates the community relations program that the U.S. Department of Energy-Richland Operations Office, the U.S. Environmental Protection Agency-Region 10 Office, and the Washington Department of Ecology will cooperatively implement throughout the cleanup of all the operable units at the Hanford Site. All community relations activities associated with the 200 West Area Carbon Tetrachloride IRA will be conducted under this overall Hanford Site CRP.

The public will have a 30-day period to review and comment on the formal IRA Proposal for the 200 West Area Carbon Tetrachloride IRA. In addition, the public will be informed on the progress of the IRA through quarterly public meetings, a project fact sheet, and will also have access to the official administrative record file for the IRA project.

AGREEMENT IN PRINCIPLE
Between the United States Department of Energy,
the United States Environmental Protection Agency,
and the State of Washington

THIS AGREEMENT is entered into between the United States Department of Energy (DOE), the United States Environmental Protection Agency (EPA), and the State of Washington.

WHEREAS, the parties to this AGREEMENT have previously entered into the Hanford Federal Facility Agreement and Consent Order on May 15, 1989, (Tri-Party Agreement) to provide for the coordinated efforts of all parties to assure compliance of DOE Hanford Site activities with requirements of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), including corrective actions and remedial actions required by those Acts, and applicable state law; and

WHEREAS, the parties have pursuant to RCRA, CERCLA and the Tri-Party Agreement instituted the process of conducting CERCLA remedial investigations and feasibility studies (RI/FS) and RCRA facility assessments and corrective measures studies (RFI/CMS) of operable units on the Hanford Site; and

WHEREAS, the parties are desirous of taking immediate steps to accelerate the physical restoration of the Hanford Site prior to completion of RI/FS and RFI activities through performance of expedited response actions:

NOW, THEREFORE, DOE, EPA, and the State of Washington agree as follows:

1. That each party reaffirms its commitment to the Tri-Party Agreement.

2. That USDOE reaffirms its obligations and commitment to seek sufficient funding from Congress to meet all existing milestones in the Tri-Party Agreement and future new milestones or revised milestones established by agreement of the parties in accordance with Article XL of the Tri-Party Agreement.

3. DOE has identified a list of potential Hanford Site projects which may be considered for expedited response actions. Candidate projects under consideration for expedited response actions, include, but are not limited to:

   a. 618-9 Burial Ground Remediation
   b. 300 Area Process Trenches Sediment Removal
   c. 200 West Area Carbon Tetrachloride Treatment.

4. DOE will propose the selected projects to Ecology and EPA for their review of the technical basis, costs and feasibility for these projects. The three parties will jointly propose to the public those projects if they meet regulatory approval. The three parties will follow the public involvement procedures of the Tri-Party Agreement and the CERCLA National Contingency Plan.

Exhibit 2
page 1 of 2

5. Following regulatory and public review, DOE commits to implementing these three candidate projects, or other appropriate projects from the list, pursuant to a schedule agreed upon by the three parties. DOE commits to the implementation of these projects as additions to the Tri-Party Agreement and without an impact on the existing milestones of the Tri-Party Agreement.

6. In order to understand the total activities under consideration and to establish a baseline for the activity which can be used as a basis for decisions and against which progress can be measured, the initial step for each of the potential projects is the development of a detailed cost estimate based upon that plan.

7. These activities will be conducted in a manner consistent with prudent management and will serve as a model for future activities in the Environmental Restoration and Waste Management Program.

8. The parties will use their best efforts to complete the steps identified in the foregoing paragraphs as soon as practical.

NOW, THEREFORE, the parties hereto have signed this AGREEMENT in recognition of their pledge of mutual best efforts to achieve through cooperation and negotiation, in good faith, the understandings as set forth above on this 18th day of October, 1990.

James D. Watkins
Secretary of Energy

William Reilly, Administrator
U. S. Environmental Protection Agency

Honorable Booth Gardner, Governor
State of Washington

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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

90-ERB-194 December 6, 1990

Mr. Paul T. Day
Hanford Project Manager
U. S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352

Mr. Timothy L. Nord
Hanford Project Manager
State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, Washington 98504-8711

Dear Messrs. Day and Nord:

INTERIM RESPONSE ACTIONS

Enclosed are the proposed interim response action (IRA) summary packages which were presented and discussed in the November 26, 1990, meeting on this subject. Based on the discussions in the meeting, the schedules have been reviewed and the following modifications made:

- The analyses for site evaluation are assumed to be Contract Laboratory Program (CLP) Level II, field screening. This assumption reduces the critical path by four weeks for two of the IRAs.
- The overall durations for preparation and approval of IRA proposals have been reduced by four to five weeks of review time and two weeks of revision time. This schedule reduction requires that Westinghouse Hanford Company, U. S. Department of Energy, Richland Operations Office, U. S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and the public all review the document in parallel.

At the November 26th meeting, EPA requested that an additional cost and schedule estimate be prepared for excavating the 300 Area Process Trenches and placing the soil in the North Pond as an alternative to the proposal in the summary package of treating the contaminated soil. It is estimated that this removal and storage action could be accomplished within one year of approval to proceed, and would cost approximately $2 million. The main assumption for this alternative is that the lead regulatory agency (EPA) would provide the necessary waivers and/or variances required to place the materials in the North Pond. An additional assumption is that there would be no undue delay in obtaining any required permits to conduct the removal activities. The

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Exhibit 3
page 1 of 2

material would be excavated while the trenches are still in operation. This could require temporary restrictions in the amount of effluent discharged to the trenches for a limited time.

Since the November 26th meeting, a number of discussions have taken place with EPA regarding additional acceleration of schedules, including the need to "take time critical actions." We would appreciate receiving specific, formal direction regarding schedules and actions not included in the enclosed summary packages, e.g. conduct of the "removal/storage action for the 300 Area Process Trenches."

The funding required in Fiscal Year 1991 to initiate the four IRAs as proposed in the summary packages is as follows:

1.	618-9 Burial Ground	5.0 M
2.	200-W Area Carbon Tetrachloride	3.7 M
3.	300 Area Process Trenches	$ 1.0 M
4.	N-Springs Groundwater Contamination	9.0 M

Rough Order-of-magnitude cost estimates are included in each of the IRA summary packages.

To maintain the schedules in the enclosures, approval by EPA and Ecology on the selection of IRAs on which to proceed is required by December 7, 1990. Additionally, as noted above, specific direction is requested regarding further acceleration and/or substantive change in scope.

If you have any questions, please call Ms. Julie Erickson at (509) 376-3603, or Mr. R. K. Stewart at (509) 376-6192.

Sincerely,

Steven H. Wisness
Hanford Project Manager

ERD:RKS

Enclosures: As stated.

cc w/encl:
J. V. Antizzo, EH-232
J. C. Lehr, EM-442
Administrative Record
Public Repositories (encl. by WHC)

cc w/o encl:
W. L. Johnson, WHC
R. E. Lerch, WHC
T. M. Wintczak, WHC
T. B. Veneziano, WHC

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STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

December 12, 1990

Mr. Steve Wisness
Hanford Project Manager
U.S. Department of Energy
P.O. Box 550
Richland, Washington 99352

Re: Hanford Interim Response Action Preliminary Proposals

Dear Mr. Wisness:

The following comments address the <u>Hanford Interim Response Action Preliminary Proposals</u> dated November 26, 1990, the DSI entitled "Expedited Response Action (ERA) Summary Packages" dated November 30, 1990, and the December 6, 1990 letter to Ecology and EPA referencing "Interim Response Actions".

As you know, Ecology has advocated and continues to support the goal of identifying candidate sites at Hanford for interim remedial actions. It was encouraging to learn that USDOE and EPA met in late September and early October to discuss this issue. It appears these meetings were productive, and have lead toward progress being made.

The parties to the <u>Hanford Federal Facility Agreement and Consent Order</u> are now at an important juncture in setting precedent for remedial activities at Hanford. We believe it is critical these activities are: 1) environmentally justified; 2) protective of human health; 3) technically correct; and 4) consistent with federal and state regulations; and the Agreement. The remainder of this letter documents general and specific concerns we have with the proposals that should be addressed prior to submittal of the formal proposals.

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General Comments

- The IRA selection process is subjective. The parties should agree upon a decision-making process that is consistent with the Agreement and the Hanford Past Practice Strategy. This process must include a methodology, criteria, quantification of the criteria and final evaluation.

Wisness, S.
Page 2

The annotated outline in the proposal package notes in Section 4.0 that "the types of evaluation criteria utilized will be based on the EPA's 'Nine criteria for evaluation as listed in 40 CFR Part 300.430'." The criteria are presented, but the entire text is vague. How will these criteria be evaluated, applied and quantified?

We recommend using CERCLA and RCRA guidance and criteria to develop a single process for Hanford past practice sites. Most important, the agencies must agree what criteria will be used, and how those criteria will be quantified in order to provide a consistent, technically defensible process for defining potential areas needing interim action at Hanford.

The introduction references seven sites originally considered in the selection process. There is no mention for the record now or in the future, of how the three (four?) proposed projects were given a higher priority, and what sites are being deferred for further consideration. The original options need to be addressed. In addition to those sites deferred, Ecology believes additional sites to be reviewed in the near future should include, for example, the "pluto" cribs in the 100-HR-3 Operable Unit e.g., 116-D-2, and the cyanide plume associated with the 200-BP-1 Operable Unit.

- o The proposals should address how schedules/milestones will potentially be affected. The fact that concurrence of all project managers would be required in accordance with Section 7.2.4. of the Agreement should be presented. For example, removal action in the 300 Area trenches must be discussed in terms of meeting existing milestones. The proposal for pump and treatment of ground water in the 100-N Area should reference potential impacts on planned geohydrological studies.

- o The November 30 and December 6 cover letters propose a 30-day parallel review period. We do not see the advantages in proposing remedial activities to the public prior to the agencies agreeing on priorities, and the best course(s) of action. This process could raise substantial questions by the public that the agencies could have difficulty in providing clear answers. At this time, Ecology will not review and approve an IRA proposal that has not had prior approval by USDOE. Ecology recommends adherence to requirements set forth in the NCP and the Agreement.

  The review periods for the public must be consistent among all proposals.

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Exhibit 4

Specific Comments

These comments are not intended to be inclusive of all concerns, but serve as examples of issues that should be addressed in the final IRA proposals.

618-9 BURIAL GROUND

- There is no evidence of leakage, and the drums may be structurally sound as to preclude the need for immediate pumping. However, pumping appears to have been determined necessary before adequate site characterization has occurred. The text should be modified.

- The site evaluation includes exposing and pumping out the drums, although the site evaluation would be completed prior to regulatory approval (Section 4.5). However, Section 4.3.4 states that removing liquids from the drums would be part of implementation of the IRA, which would require regulatory approval. The latter is correct, and the former is not, i.e., pumping the drums prior to regulatory approval is contrary to the Agreement and CERCLA.

N-SPRINGS GROUNDWATER

- We concur the N-Springs discharge represents one of the most serious environmental threats emanating from the Hanford Site, and support interim remedial action at this site. However, the measure of remedial success needed, and the ability to meet those objectives using pump and treat technology must be assessed. Contaminants other than Strontium-90 that can be removed using an ion exchange column should be addressed.

300 AREA PROCESS TRENCH

- Continued discharge after excavation might cause further environmental degradation. This point should be addressed in the proposal.

- The depth and extent of contamination in the trenches is poorly defined, and the measure of success desired in removal actions has not been addressed. Therefore, the volume of excavation needed is unknown, and the anticipated degree of remediation cannot be determined. These questions cannot be answered without further study, but the proposal text does not reflect these uncertainties. In fact, a proposal of $1.0 M dollars has been tentatively allocated for this remedial action with little explanation of what is to be accomplished.

Wisness, S.
Page 4

- It is assumed in Section 4.4.3 that this IFA would be conducted as a CERCLA activity under EPA lead, although the trenches are a RCRA interim status facility. The state has jurisdiction over waste removed from the trenches, and this fact should be noted in the proposal.

- Section 4.1 states the proposed action is not expected to interfere with remedial activities within the 300-FF-1 Operable Unit. However, it was stated at the December 3, 1990 Interim Response Actions meeting held in Richland that dredging the trenches and placing the excavated sediments in the North Pond was considered a viable and attractive option. Placement of large volumes of wastes in the North Pond would certainly affect operable unit remedial activities.

- The North Pond alternative will not meet the reduction of waste measure of success identified in Section 4.2 of the proposal.

- It is not clear in the proposal where 1000 cu. yd. of dry waste, 4000 drums of hazardous waste, and 4000 drums of mixed waste will be stored or treated. There should be at least several options presented at this point in the process.

200-W CARBON TETRACHLORIDE

- The proposal should discuss more fully the potential to address ground water contamination in addition to vadose zone contamination. Why, for example, is ground water remediation deemed to complex due to the presence of radioactive contaminants?

- The criteria for discontinuing treatment is ill-defined in Section 4.4.4. and should be expanded.

We look forward to the meeting scheduled for December 14, 1990 in Kennewick in order to discuss the IRA program in general, and our concerns in particular. If you have questions before then, please contact Larry Goldstein at (206) 438-7018.

Sincerely,

Timothy L. Nord

Timothy L. Nord
Hanford Project Manager
Nuclear & Mixed Waste Management

cc: Roger Stanley
Paul Day, EPA
Tim Veneziano, WHC

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ATTACHMENT 3

VACUUM EXTRACTION SYSTEM

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VENDOR EQUIPMENT AND SERVICES SPECIFICATION
SOIL VENTING SYSTEM
WESTINGHOUSE HANFORD COMPANY

SPECIFICATION NO. E-91-13-001

PROJECT SCOPE

The vendor will design, assemble, calibrate, pre-test and deliver a soil venting system for Westinghouse Hanford Company (WHC). The vendor will provide "dry run" training for WHC technicians at the vendor's site, and will provide onsite support during the soil venting tests at Hanford.

EQUIPMENT TO BE PROVIDED BY VENDOR

Figure 1 shows the conceptual flow diagram for the soil venting test apparatus. Table 1 lists the equipment that will be provided by the vendor. Table 2 lists the items that will be supplied by WHC. Table 3 itemizes the overall length of flexible vacuum hose and signal cable that will be required. Table 4 lists the items that will be required for the data aquisition system and automatic system shutoff in the event of a system failure ~~(note: system failure might include high alpha/beta radiation, high inlet LEL, or high VOC concentration at the exhaust stack).~~

As shown in Figure 1, the vacuum pump (or several pump modules) must be capable of meeting a wide range of flowrate conditions without using bleed air. The vendor is encouraged to provide more than one pump module if they feel that it will improve the reliability of the system.

SERVICES TO BE PROVIDED BY VENDOR

The vendor will provide the following services in addition to the equipment described above:

- o As part of the lump sum price, provide an Operation and Maintenance Manual for all of the supplied equipment, plus a spare parts list with a recommended spare parts inventory. As soon as possible after the bid award, the vendor will provide Ebasco with the recommended spare parts list.

- o As part of the lump sum price, provide 2 days of "dry run" training at the vendor's facility on February 25 and February 26, 1991. The "dry run" testing should include all of the equipment ~~(except of the DAS system to be provided before March 9, 1991),~~ and should closely approximate the conditions that are expected to be encountered during the actual vent testing (e.g., flowrate and pressure drop; temperature; simulated VOC concentration). Five WHC technicians will attend the training session.

- o On a time-and-materials billing basis, provide one or more technicians for onsite support during the setup and vent testing between March 1, 1991 and March 18, 1991. The vendor's billing rates shall be specified as part of the bid. Note: WHC contractors are allowed to charge a maximum of $64/day for combined lodging and meals.

- o Note that, because of health and safety restrictions, the vendor's technicians will not be allowed to handle the vent test equipment after it arrives at Hanford. Instead, they will consult with WHC technicians who will actually handle the hardware. The vendor's technicians will be allowed to handle the electronic equipment that will be set up in a laboratory trailer near the vent test equipment.

EQUIPMENT TO BE PROVIDED BY WESTINGHOUSE HANFORD COMPANY

WHC and Ebasco will provide the following equipment and services listed in Table 2:

- o Ebasco will provide the Flanders Filter Model E8 HEPA filter housing, and ship it to the vendor for installation on the test trailer. The vendor must fabricate transition sections based on HEPA drawings that will be provided by Ebasco. WHC will provide the HEPA filter media that will be used inside the Flanders E8 housing.

- o A portable laboratory/office trailer, set up adjacent to the vendor's equipment trailer. The lab trailer can be used to house the vendor's electronic equipment that may be sensitive to weather.

- o A diesel electrical generator to provide power for the equipment trailer and the lab trailer. The vendor will specify the power requirements.

- WHC technicians and maintenance personnel will be the only persons allowed to handle the hardware after it is delivered to Hanford. The WHC technicians will consult with the vendor's onsite personnel.

SPECIAL EQUIPMENT REQUIREMENTS

The equipment must be suitable for the following physical conditions:

- The apparatus must be designed to allow the vented air flowrate to be fully adjusted without using bypass valves and "bleed air". One "bleed air" valve shall be installed as shown in Figure 1, to allow ambient air to be drawn into the system ONLY during initial startup and thermal equilibration. That bleed air valve shall be equipped with a check valve to prevent accidental emissions. For safety protection it will be vented to the stack via a flexible hose.

- The equipment, process piping, glues and sealants must operate with a vented air temperature up to 200 F; system static vacuum of at least 150 inches w.g. vacuum; system positive pressure of at least 60 inches w.g.; and venting of carbon tetrachloride vapor concentrations of up to 10,000 ppmv.

- The vendor's LEL and VOC monitors must be installed so that they provide stable readings in ambient temperature ranging from 10 degrees to 100 degrees F. The vendor can, if they choose, install the monitors in an office trailer that will be provided by WHC. The DAS system and strip chart recorders must be installed inside the office trailer.

- The DAS must include a strip chart recorder that records all of the data-logged parameters.

- The process piping must be constructed of steel. Construction is not subject to NQA-1 requirements for nuclear facilities. Flanged connections should be used for all primary piping and flow through equipment.

- The process piping must be suspended at least 18 inches above the ~~floor~~ TRAILER BED, to allow drainage basins to be placed under any flanges that are disconnected for maintenance.

- The GAC canisters shall be of steel construction and satisfy the DOT "Flammable Liquid" specification for shipment and disposal. They must be able to withstand the pressure and/or vacuum induced by the pumps.

- The vendor must demonstrate that the system is leak-tight. The "pressure decay" leak check specified in ANSI N-510-1980 and in Table 4-4 of ANSI N-509-1980 shall apply.

- The equipment (EXCLUDING the GAC canisters) shall be fastened on a flat bed trailer so that it can be transported in conformance with all applicable federal, state and local transportation regulations. The equipment must be installed on the trailer in a configuation that allows for easy access, maintenance and replacement of each individual item. The prefilter housing and HEPA filter housing must be mounted to provide easy access for filter media changeout as needed.

- The vendor is responsible for ensuring that the sample lines are designed to optimize response time and minimize line losses even under freezing weather conditions.

- Exhaust gas from all sampling pumps and atmospheric vents must be collected and pumped back into the process ductwork.

- The GAC canisters are to be delivered to the Hanford site on a standard flat bed trailer (separate from the equipment trailer described above). WHC will transfer the canisters onto another trailer that will be used to transfer them to the test site. The vendor will provide flexible hose to connect the GAC canisters to the venting system. The canisters will be placed on the ground as close as possible to the venting trailer.
  TO ALLOW ABOUT 10' FROM THE VENTING TRAILER.

- The vendor will provide all supplies and equipment needed for onsite calibration of the LEL and FID/VOC monitors. The vendor will instruct the WHC technicians on how to calibrate the monitors during the initial "dry run" training.

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GAS SAMPLING SYSTEM REQUIREMENTS

WHC laboratory technicians will collect the gas samples to be analyzed for particulate and gaseous components. The vendor will provide the following empty "bench spaces" on the equipment trailer, to be used by WHC to collect the gas samples:

- One "bench space" will be next to the gas sample ports S-1 to S-4, and will be about 3 feet by 4 feet in area. It will be used to hold the various sample pumps and sample media to be used by WHC.

- One "bench space" will be at the "compliance monitoring point" downstream of the HEPA filter. It will be used to hold an Alpha CAM and Beta CAM, and will be about 3 feet by 5 feet in area.

- One "bench space" will be at the process pipe bewteen the in-series GAC canisters, and will be used to hold an Alpha CAM and booster pump. It will be about 3 feet by 3 feet in size.

The vendor will provide gas sampling ports that WHC will use to extract the samples. Figure 1 shows the port locations. Figure 3 shows the construction of the ports.

As shown in Figure 1, the vendor will discharge exhaust gas from the monitoring equipment sampling pumps back into the process piping.

DESIGN SKETCH REVIEW AND CONSTRUCTION INSPECTIONS

Within two days after being awarded the bid, the vendor will provide Ebasco with scaled sketches of the equipment arrangement on the test trailer, clearly showing the arrangement of the "bench spaces". Before the vendor proceeds with construction, Ebasco will approve or identify required modifications to the sketches within 4 workday hours after receipt of the sketches.

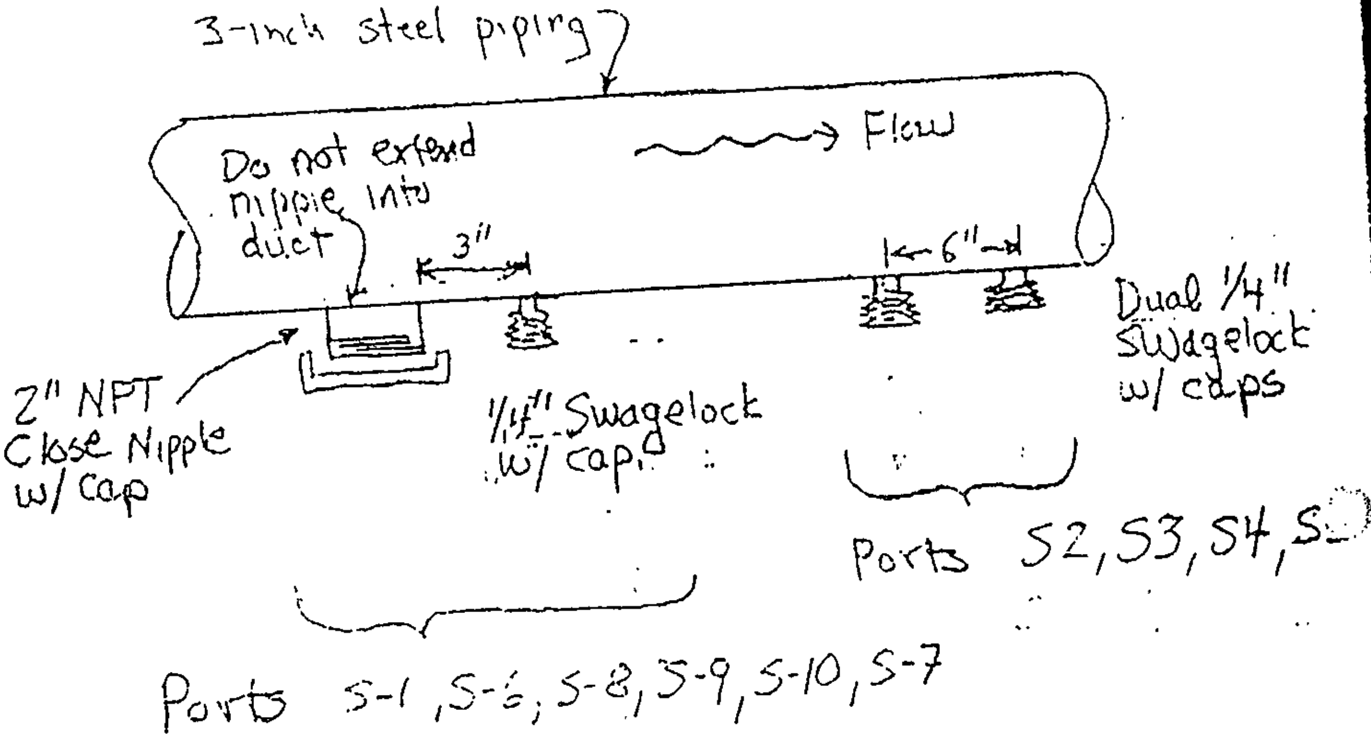
Ebasco will inspect the system at about 25 percent completion, and advise the vendor on any changes that are needed to provide the proper configuration for gas sampling and equipment maintenance.

Calculations

HARTCROWSER

Page ____ of ____
Job No. ____
Date 2/11/91
Made by JMW

Project ____
Calculations for ____



Notes

1. Ports to be installed horizontally.

Figure 3
Gas Sample Ports

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Calculations

HARTCROWSER

Page 1 of 1
Job No. 29784-1
Date 2/7/91
Made by JMW

Project Westinghouse Hanford
Calculations for Well Head Adaptor

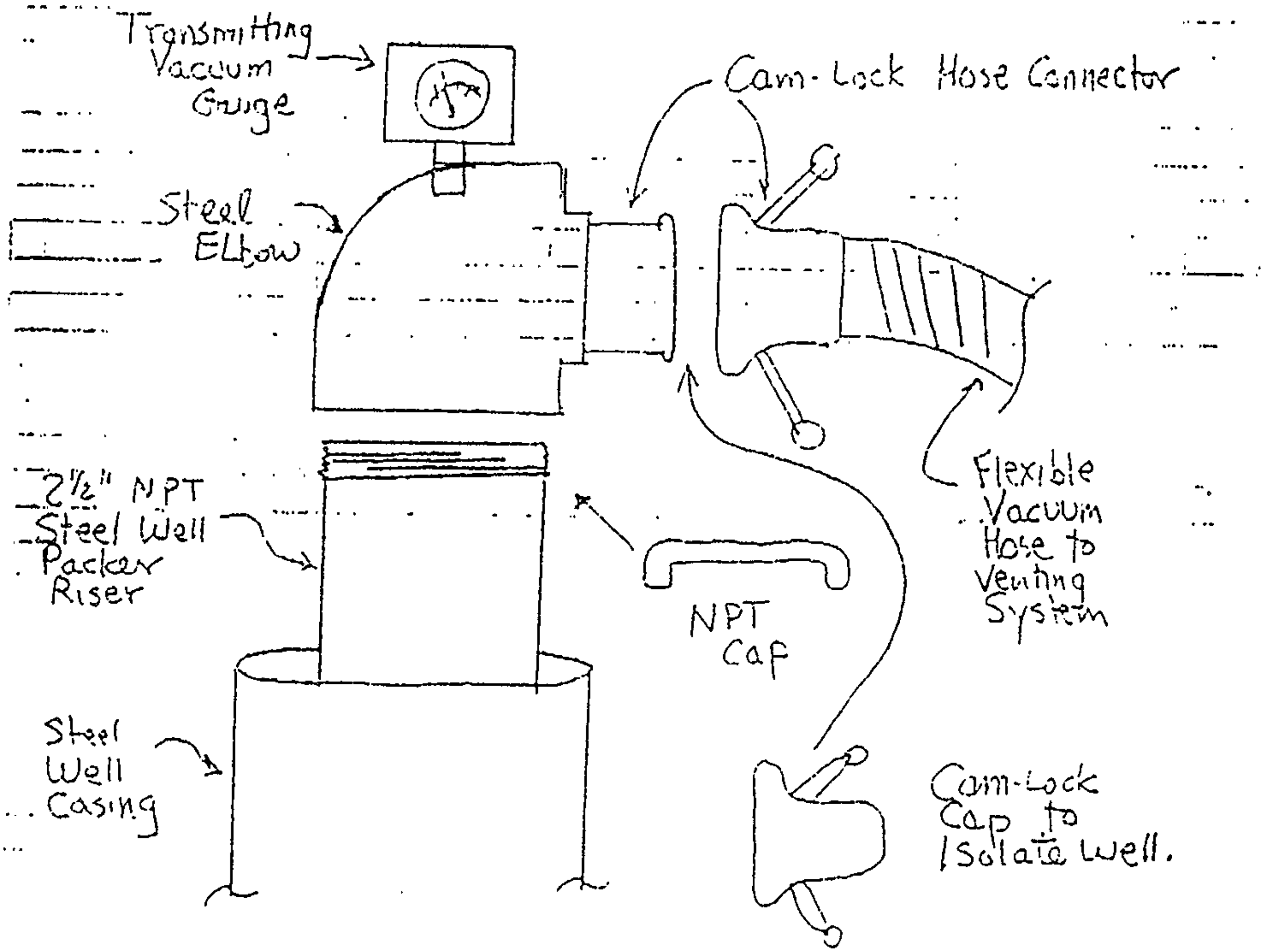

Figure 2
Well Head Adaptor
(4 total)

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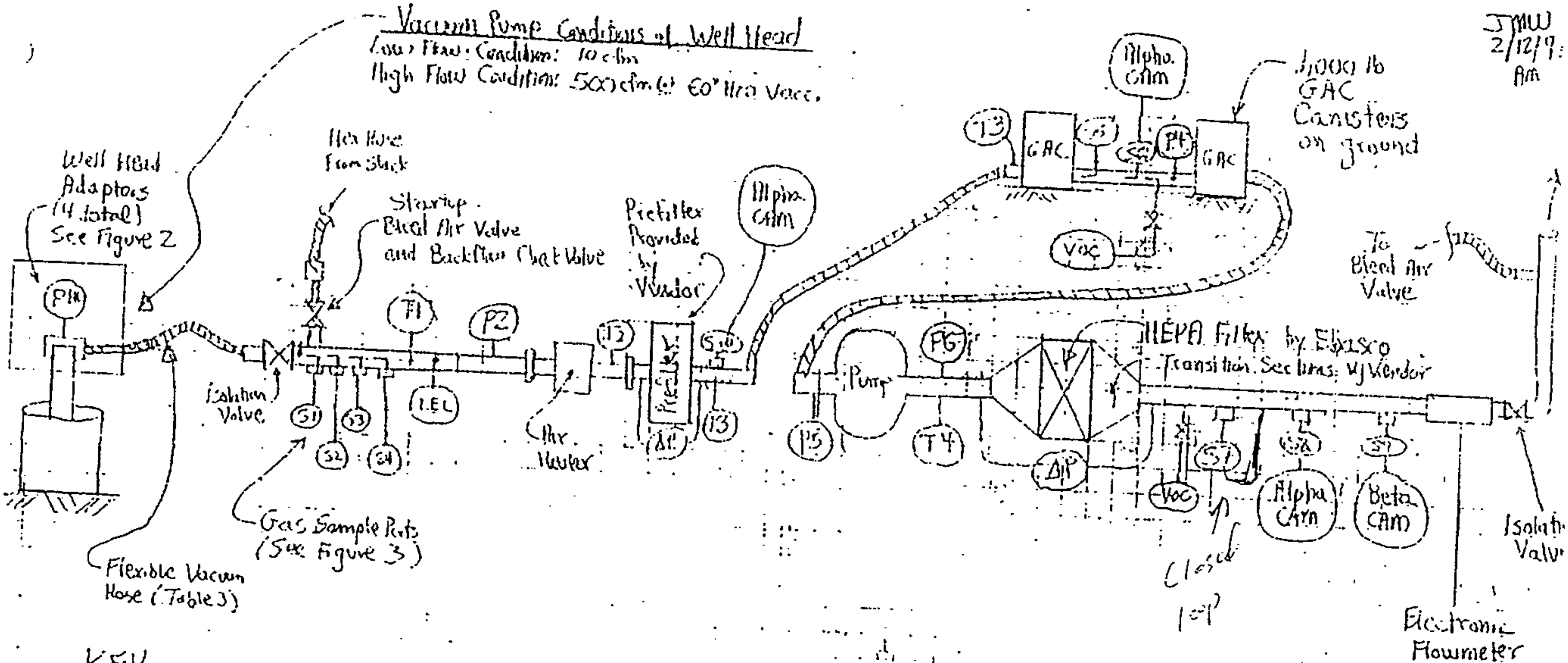

KEY

(P1*) Transmitting Vacuum Gauge (4 total)

(T1) Thermocouple

(S1) Gas Sample Port (Figure 3)

(VOC) Flame Ionization Organic Analyzer

(LEL) Explosivity Monitor

(ΔP) Mechanical Differential Pressure

(P3) Mechanical Vacuum/Pressure Gauge

(Alpha-CAM) Alpha monitor provided by WHC

(Beta-CAM) Beta Monitor provided by WHC

FIGURE 1
VENTING SYSTEM FLOW DIAGRAM

Table 1
Summary of Equipment Requirements
Westinghouse Hanford Company Soil Venting Apparatus
Lotus "Eqspec1"

Item	Description	Quantity	Performance Range
P1*	Venting well vacuum (transmitting w/ local)	1	0 - 100 in. H20 vacuum
P2, P3, P4, P5	Process vacuum gauge (mechanical)	1	0 - 150 in. H20 vacuum
P6	Process Pressure gauge (mechanical)	2	0 - 60 inch wg pressure
P7	Barometric Pressure gauge (transmitting)	1	Ambient conditions
P8,P9,P10	Observation well vacc (transmitting w/ local)	3	0 - 2 inch w.g. vacuum
Del P	Mechanical differential pressure	2	0 - 10 inch wg
T1 - T3	Process temp. transducers (transmit w/ local)	3	20 - 150 F
T4	Ambient Air Thermocouple (transmitting)	1	0 - 120 F
S1 - S9	Gas Sample Ports	9	2 inch capped nipples.
Air Heater	Noncontact electric air heater w/ temp control based on air temp at GAC canisters (Probe T3)	1	500 cfm; 40F inlet; 100F outlet
LEL	Explosivity Monitor (Transmitting)	1	0 - 100% LEL
VOC	FID Monitor (transmitting) Multiplexing between 3 points	Vendor Specify	0 - 10,000 ppmv Resolution < 5 ppm
Flow Meter	In-line transmitting flowmeter	1	5 - 500 cfm 100 F
GAC	1,000-lb GAC canisters Steel, DOT "Flammable Liquid" shippable	3	N/A
Vacuum Pump	Pump Module	1	See Figure 1
HEPA Filter Transitions	Transition sections between HEPA filter and process piping	1 Filter	Vendor Specify
Well Head Adapters	Well caps for flexibe hose connection and vacuum gauge.	4	See Figure 2
Flex Hose	Flexible vacuum hose for 150" vacuum	See Table 3	Temp range 10 F - 200 F

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Item	Description	Quantity	Performance Range
Recorder 1	Strip Chart Recorder(s) for Vacuum Gauges, Thermocouples, VOC analyzers, Flow Meter and LEL Monitor	Vendor Specify	Vendor Specify
DAS	Data Aquisition System and Process Logic Control shutoffs	1	See Table 4
Trailer	Permanent flat bed trailer to support all equipment except for GAC.		
Isolation and Bleed Valves	Full-bore 3" ball valves	3	
110-v AC Power	Step down transformer and power conditioning for all vendor-supplied equipment, PLUS provide additional 40A of conditioned 110-v AC power for additional WHC sampling equipment.		

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Table 3
Flexible Hose and Signal Cable Distances
Westinghouse Hanford Soil Venting System
Lotus "eqspec3"

Well No.	Expected Max Flowrate (cfm)	Distance From Equipment Trailer (feet)	Est. Vacc.Hose (Feet)	Est. Signal Cable (Feet)
87	10	30	50	50
171	500	60	75	75
150	10	130	150	150
159	10	300	350	350
Office Trailer	N/A	30	40	40
GAC Canisters	N/A	10	30	30

<u>Notes</u>
1. Assume GAC canisters will be placed on ground as close as possible to the equipment trailer.

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ATTACHMENT 4

CARBON TETRACHLORIDE VAPOR EXTRACTION/POSSIBLE PLUTONIUM AND AMERICIUM CONTAMINATION IN THE EXTRACTED VAPOR

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Westinghouse
Hanford Company

Internal Memo

From: Technical Baseline Section 81223-91-003
Phone: 6-0396 H4-55
Date: February 6, 1991
Subject: Carbon Tetrachloride Vapor Extraction/Possible Plutonium and Americium Contamination in the Extracted Vapor

To: M. R. Adams H4-55

cc: D. R. Ellingson B1-35
D. O. Hess L6-57
E. G. Hess R3-09
W. L. Johnson H4-55
R. D. Lichfield L6-55
TEM: File/LB H4-55

The position will be taken that Plutonium (Pu) and Americium (Am) will not be extracted by the 850 millibar or less vacuum applied to remove the CCl_4 in the 200-W area as described in the Interim Response Action. This position will be substantiated utilizing 1) the vapor pressure characteristics of liquids, gases, and metals, 2) soil plutonium and americium characterization, and 3) the mobility of Pu and Am given the specific soil characteristics of the 200-W area.

Vapor pressure characteristics of liquids, gases, and metals

The process of the vapor extraction technique relies on the process of vaporization, in which a liquid is converted to a vapor. The ability of an element (or compound) to enter into the vapor phase, or to volatilize, is dependent on the vapor pressure, which is the pressure of the vapor in equilibrium with the liquid or solid from which it originates. The vapor pressure is a characteristic property of a given liquid or solid, and varies with the strength of the intermolecular forces. In the process of vaporization, molecules continually leave the substance in question until the starting substance is exhausted, exemplified in an open system, or until an equilibrium is reached, exemplified in a closed system. The vapor extraction technique emulates an open system by preventing equilibrium between the gas and the liquid. Sisson and Ellis, 1990, depict the maximum vacuum to exist in the ground using the vapor extraction technique to be 850 millibar pressure, or 638 mm Hg. This vacuum is not substantial, being slightly less than atmospheric pressure, but inhibits the equilibrium between the liquid and gas, thus increasing the vaporization rate. An analogy to this is the boiling of water at temperatures lower than 100° C. Evacuating the volume containing the water to 24 mm Hg at a temperature of 25° C causes water to boil and vaporize more rapidly. Material with higher vapor pressures than water will evaporate quicker or vaporize more readily. Carbon tetrachloride (CCl_4) is characteristic of a liquid with a much higher vapor pressure than water. To obtain a vapor pressure of 760 mm Hg a temperature of 76.7° C is required, compared to 100° C needed for water. In terms of a constant temperature, at 20° C, CCl_4 exhibits a vapor pressure of 90 mm Hg, and water exhibits a vapor pressure of 17.5 mm Hg.

Of the 106 known elements 81 are classified as metals. Metals as a class do not volatilize in the range of normal atmospheric pressures and temperatures. Mercury is the easiest to volatilize, requiring a temperature of 357° C to maintain a vapor pressure of 760 mm Hg. As an example of the low volatility of the transuranics, Uranium has a melting point of 1132° C, and a temperature requirement of 3800° C to maintain a vapor pressure of 760 mm Hg. The melting points of Pu and Am metals are 640° C and 1173° C, respectively. For Am to vaporize, a temperature of 2600° C is required. To induce volatility of the transuranics obviously requires a substantial energy input. Comparing the temperature required for CCl_4 to maintain a vapor pressure of 760 mm Hg, 76.7° C, to that of Uranium, 3800° C, and realizing the high melting point temperatures of Pu and Am, one can conclude that to induce volatility of the transuranics is quite difficult. However, it must be noted that these temperatures and pressures reference the pure metallic forms of Pu and Am. Price et al., 1979, indicates that the acid liquid effluent containing the Pu and Am hydrolyzed the mineral constituent in close proximity. The Pu and Am not complexed at the exchange sites of the soil, were involved in reactions with the alkaline earth metals released from the hydrolysis. This resulted in the oxide formation of the respective metals, PuO_2 and AmO_2. Benedict et al., 1981, references the melting point of PuO_2 to be 2400° C, substantially higher than the pure metal form. Although the melting point for AmO_2 in this text is not referenced, stability of this compound is indicated up to 1000° C. These facts further corroborate that volatility of Pu and Am in the soil at 20 - 25° C in an open evacuated system of 638 mm Hg, will not occur.

Soil plutonium and americium characterization

In general, ion exchangers favor the binding of ions of higher charge, decreased hydrated radius, and increased polarizability. Polarizability refers to the ability of an ion's electron cloud to be deformed by neighboring charges. The following is the Lytrophic series, which is a basic description of the preference of cations for binding to negatively charged sites (the predominant charge in soils).

Pu^{4+}, Am^{3+}, » La^{3+} > Ce^{3+} > Pr^{3+} > Eu^{3+}> Y^{3+} > Sc^{3+} > Al^{3+}»
Ba^{2+} >Pb^{2+}> Sr^{2+} > Ca^{2+} > Ni^{2+} > Cd^{2+} > Cu^{2+} >
Co^{2+} > Zn^{2+} > Mg^{2+} > $(UO_2)^{2+}$ » Tl^{+} > Ag^{+} > Rb^{+} > K^{+} >
$(NH_4)^{+}$ > Na^{+} > H^{+} > Li^{+}

Observing from the series, Pu^{4+} and Am^{3+} are most preferentially held at the exchange site, and consequently have the highest binding energy. Once plutonium comes in contact with either soil or sediment, it becomes firmly attached to the host particles. This strong attraction is exemplified by the high adsorption coefficients in laboratory studies with soils (Rhodes 1957, Prout 1958). The distribution coefficient, Kd, which is defined as the ratio of adsorbed plutonium per unit weight to that in solution per unit volume, ranged from about 1,000 in laboratory studies to about 100,000 in actual field situations. The high Kd in aged field situations compared to the lower Kd for short term laboratory situations indicates that with time the natural occurring soil and geochemical processes increases the retention of Pu. The case of the high Kd would apply to the Pu in the ground underneath the 200-W cribs. Sorption studies of Am on soils is limited compared to Pu soil sorption. Routsen et al., 1975 determined the Kd's for an arid soil of neutral pH to be greater than 1200. The high Kd's for both Pu and Am indicates soil retention and restricted mobility.

Mobility of Pu and Am given the specific soil characteristics of the 200-W area

In the 200 W area, the 216-Z-1A crib received an estimated 57 Kg of Pu, 1 Kg of Am, and unknown amounts of actinide bearing acid waste liquids (Price et al., 1979). The actinides of concern are $^{239,240}Pu$ and ^{241}Am. After 10 years from the last documented release of actinides, the bulk of the $^{239,240}Pu$ and ^{241}Am contamination appears to be contained within the first 15 meters of sediments beneath the crib, with a maximum penetration for both $^{239,240}Pu$ and ^{241}Am to 30 meters below the facility. The spread was greater in the lateral direction than vertical. The lateral spread of the waste effluent was attributed to the stratification of the soil texture beneath the crib. Medium to very fine sand overlays pebbly very coarse to medium sand. Because of the unsaturated flow principle, this naturally occurring soil textural stratification acted as a natural barrier for the downward migration of the actinides. The bulk of the contamination is contained within the medium to fine sand layer which has a particle size range of 500μm - 125μm diameter.

The Pu that attaches itself to host soil particles has been verified directly by microscopic and alpha-track measurement techniques. Mork (1970) studied the size association of Pu in Yucca Flat on the Nevada Test Site and showed that most of the Pu was associated with soil particles greater than 44μm in diameter. Tamura (1975) studied soil samples from the Nevada Test Site and found that the particle sizes most closely associated with Pu was the coarse silt fraction (50μm-20μm dia) and the fine sand fraction (125μm-50μm dia). Since ^{241}Am is a decay product of ^{239,240}Pu and exhibits the same affinity for soil complexation as ^{239,240}Pu, ^{241}Am will exhibit similar particle size associations. Substances with a mass light enough to be pulled from the ground during the vapor extraction are particulates that could be associated with either ^{239,240}Pu or ^{241}Am. However, the soil textural class at the depth of maximum concentration of ^{239,240}Pu and ^{241}Am beneath the Z crib is medium to fine sand with a particle size range of 500μm - 125μm diameter, with a pore space diameter of about 60μm (Brady, 1984). If these particles can be physically moved by the vacuum, which is highly unlikely, either downward or lateral movement of the 500μm - 125μm diameter particles is impeded by the 60μm diameter pore space of the medium to fine sand. From Sisson and Ellis, 1990, an in-line HEPA filtration system is incorporated in the design of the vapor extraction system, to prevent the transport and subsequent accumulation of non-desirable substances. The HEPA filtration system entraps 99.97% of airborne particulates > .3 μm diameter. From the information presented in this paragraph and previous section, the conclusion is made that there is little chance of outside transport, via vapor extraction, of ^{239,240}Pu and ^{241}Am in the volatile state or associated with soil particles.

T. E. Moody

T. E. Moody, Ph.D.
Sr. Scientist

Concurrence:

R. D. Lichfield Date: 8 Feb. 91

R. D. Lichfield, Manager
HWVP and Environmental Safety Assurance

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ATTACHMENT 5

CRITICALITY HAZARDS OF

CARBON TETRACHLORIDE

IRA PROJECT

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ENGINEERING DATA TRANSMITTAL

1. EDT 112901

2. To: (Receiving Organization) Hanford Restoration Operations	3. From: (Originating Organization) Criticality Engineering Analysis	4. Related EDT No: N/A
5. Proj/Prog/Dept/Div: Restoration & Remediation	6. Cog/Proj Engr: A. L. Hess	7. Purchase Order No: N/A
8. Originator Remarks: Issuance of CSAR 80-024, Addendum 4, to cover CCl_4- extraction operations in 216-Z-1A, 216-Z-9 and 216-Z-18.		9. Equip/Component No: N/A
		10. System/Bldg/Facility: 200W Area
11. Receiver Remarks:		12. Major Assm Dwg No: N/A
		13. Permit/Permit Application No. N/A
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No	(D) Rev No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-SQA-CSA-20334		0	CSAR 80-024, Addendum 4; Criticality Hazards of Carbon-Tetrachloride IRA Project in 200 Area Cribs	2	1		

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 see MRP 5.43 and EP-1.7	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp
1	1	Cog./Proj. Eng	A L Hess	2/13/91	R3-01						
1	1	Cog./Proj. Eng. Mgr.	[signature]	2/14/91	R3-01						
1	1	QA	[signature]	3-5-91	H4-16						
1	1	Safety	[signature]	2/15/91							
1	1	Tech. Review	[signature]	2/14/91	R3-01						

18. A L Hess 2/13/91 — Signature of EDT Originator, Date

19. [signature] 3/8/91 — Authorized Representative for Receiving Organization, Date

20. C A Rogers for PC Doto 3/11/91 — Cognizant/Project Engineer's Manager, Date

21. DOE APPROVAL (if required) Ltr No.
- [ ] Approved
- [ ] Approved w/comments
- [ ] Disapproved w/comments

BD-7400-172 (2/89)

To Distribution	From Criticality Engineering Analysis	Page 1 of 1	Date March 13, 1991
Project Title/Work Order CSAR 80-024, Addendum 4: Criticality Hazardsof Carbon Tetrachloride IRA Project in 200 Area Cribs		EDT No 112901	ECN No N/A

Name	MSIN	With Attach.	EDT/ECN & Comment	EDT/ECN Only
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1. Total Pages 9

2. Title	3. Number	4. Rev. No.
CSAR 80-024, Addendum 4; CRITICALITY HAZARDS OF CARBON TETRACHLORIDE IRA PROJECT IN 200-AREA CRIBS	WHC-SD-SQA-CSA-20334	0

5. Key Words

Carbon tetrachloride, TRU Waste Cribs, Z-9 Enclosed Trench, Vapor Extraction, Critical Pu Concentration

6. Author

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Signature

29210/ES61A

Organization/Charge Code

7. Abstract

A proposed plan for removing carbon tetrachloride from soil around three cribs of the 200-West area was reviewed for criticality safety. Given the nature of the project and the soil plutonium distributions, it is not expected that sufficient material could be arranged into a critical configuration. Precautions are necessary due to the total amounts of Pu in the cribs and the uncertainties about its local concentrations. Procedures involving relocation of appreciable amounts of soil will require reviews by Safety Assurance. Soil extracted from the areas, from drilling or sampling, must be treated as suspect TRU solid waste. Water additions also are to be restricted.

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CSAR 80-024, Addendum 4

Criticality Safety Evaluation Report
for Criticality Prevention Specifications CPS-T-149-00028, Rev. B-0

Title: HAZARDS OF CARBON TETRACHLORIDE IRA PROJECT IN 200-AREA CRIBS

Prepared by: Allen L Hess Date: 2/13/91
Engineer, Criticality Engineering Analysis

Reviewed by: [signature] Date: 2/14/91
Engineer, Criticality Engineering Analysis

Approved by: [signature] Date: 2/14/91
Manager, Criticality Engineering Analysis

Approved by: F.G. Hess [signature] Date: 3-11-91
Manager, HWVP & Environmental Safety Assurance

1. INTRODUCTION AND SUMMARY

Project plan WHC-SD-EN-AP-046 (reference-1) for vapor extraction of carbon tetrachloride from soil around cribs of the 200-West area was reviewed for criticality safety aspects. Considering that the maximum expected soil plutonium concentrations is about 1 gram per liter, the Pu is in relatively thin layers, and the nature of the proposed operations, it is not expected that sufficient material could be arranged into a critical configuration as a result of the project. However, due to the uncertainties about the Pu concentrations, and since the cribs in question contain upwards of 150 kg total plutonium, extra precautions are necessary. If the extraction preparations could result in movements and relocation of significant amounts of the topmost soil layers, further CEA reviews of the plans are required. Soil extracted from around or beneath the crib areas, for sampling or as the result of drilling wells, etc., must be considered TRU solid waste with the associated requirements for packaging and assays. Water additions also are to be restricted.

2. APPLICABLE LIMITS AND PREVIOUS ANALYSES FOR CRIBS

The referenced plan primarily involves three liquid waste disposal facilities in the 200-West area; the 216-Z-1A Tile Field, the 216-Z-9 Trench, and the 216-Z-18 Crib. Aqueous and organic waste from plutonium recovery processes operated at Z Plant were discharged into these facilities, which are now in deactivated status. Two of these areas, 216-Z-1A and 216-Z-18, are regulated for criticality safety under the provisions of Criticality Prevention Speci-

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fication CPS-T-149-0028, a copy of which is included as Appendix A. The CPS restricts the types of activities allowed in a number of different cribs. A revision of the CPS will be needed to include the proposed CCl_4 extraction project.

The analyses supporting provisions of this CPS for deactivated cribs are reported in the initial edition of CSAR 80-024 (reference 2) and its first three addenda (references 3, 4 and 5).

The 216-Z-9 crib was designated in 1980 to be a LIMITED CONTROL FACILITY on the basis of an analysis reported in CSAR 80-004 (reference 6). The CSAR indicated that after the top 12 inches of soil was mined from Z-9, the maximum Pu concentrations from surface samples was about 0.2 g/l. The specifications issued at the time (CSC-Z-149-00010) included the following provision;

> A2. The manager of Criticality Engineering and Analysis shall approve any operation in the Z-9 trench which may change the plutonium concentration of the Z-9 soil.

As part of the objectives of this review, the 216-Z-9 trench is to be added to the list of cribs covered by CPS-T-149-00028, considering that some activities could plausibly increase localized concentrations.

3. EVALUATION OF CRITICALITY POTENTIAL

The project basically involves vacuum-assisted vaporization and extraction of CCl_4 from the organic solvent plume under cribs around the PFP, using existing and possibly new wellheads. There are three primary cribs in question; the 216-Z-1A Tile Field, the 216-Z-9 Trench, and the 216-Z-18 Crib. Plutonium bearing waste solutions or slurries were discharged into these cribs in past decades. For the 216-Z-1A Tile Field, the reference-1 report cites a maximum activity of 0.4×10^4 nanocuries per gram (of soil) for plutonium detected in various samples. This activity equates to just under 1 g Pu per liter (see Appendix B).

Pu densities as low as 0.8 g/l in soil could be considered potentially hazardous if the admixed elements had low neutron absorption properties, had little water holdup, and if there was a substantial volume of such mix. For example, a pure Pu-sand mixture (sand as SiO_2 only) with a uniform 1.0 g per liter ^{239}Pu concentration would require a 30-ft diameter sphere and 417 kg of the Pu (see attached derivation). Such pure mixtures, accumulations and distribution are clearly not representative of the crib sites.

Reference-7 provides a more plausible minimum critical concentration of about 3.5 g ^{239}Pu/liter in representative soil with 30% water saturation of voids. If the concentration could be as high as 10 g/l, the attached derivations shows that only about 3 kg of Pu would be required for criticality if appropriately shaped and reflected.

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There are indications that the Pu concentrations in thin layers near the surface of the cribs or trenches could be higher than 3.5 g/l. The Pu-activity mapping of the Z-9 trench before it was mined to remove fissile material, as reported in Figure-3 of the Z-9 mining report (reference 8), shows surface concentrations as high as 28 grams Pu per liter. It was also noted that about 58 kg of Pu was removed in the top 30 cm. of soil during mining operations, which involved strict controls for criticality safety. The reference-6 CSAR for Z-9 indicated that after removing the top foot of soil the Pu concentrations do not exceed 0.2 g/l. However, estimates are given in Draft Final HDW-EIS that 38 kg of Pu still remains in the Z-9 crib, so that the maximum concentrations may not be well known. The expressed extraction and residual values of 58 and 38 kg Pu, respectively, indicate that 96 kg total had been discharged into trench Z-9.

Reference 1 indicates that about 57 kg of Pu was discharged into the 216-Z-1A Tile Field. It is also stated that the maximum Pu activity (40x 10^4 nano curies/g) "occurred in sediments immediately beneath the crib." It is not clear if this meant in the 4-ft thick cobble layer below the distribution tiles, or in the soil beneath the cobble layer. There is no indication of what Pu residues might be held up in the vitrified clay piping. Since the drainage area covered by the tiles is about 14 times the bottom area for the Z-9 trench (25,480 ft^2 versus 1800 ft_2), one could reason that the Pu densities for even distributions in 216-Z-1A would be 57/96 x 1/14 = .042 x the densities found in the Z-9 trench. Thus, 4.2% of 28 g/l would give 1.2 g Pu/l, in line with the maximum 1 g/l derived from the activity measurements.

Similarly, for the 216-Z-18 crib with a base area of 10,000 ft^2, an even distribution of the 23 kg of Pu discharged into the crib would suggest a maximum concentration of 1800/10000 x 23/96 x 28 = 1.2 g Pu/l beneath the epoxy pipes.

The vacuum evaporation technique for extracting carbon-tetrachloride from the soil under the cribs can not be expected to draw off any plutonium with the gases, or to cause any redistribution of the material trapped in the soil. Since none of the criticality safety assessments for Pu in soil have ever accounted for the presence of high-neutron absorbers, like the chlorine of the CCl_4, the reduction of the chlorine content does not represent a new, unanalysed criticality hazard source.

Studies of the chemistry for plutonium solutions discharged to soil indicate rapid Pu adsorption onto soil particles by ion-exchange mechanisms. Unless the medium is fairly acid, the Pu concentration in the soil water should be very low because of the strength of the adsorption and due to insolubility of Pu in the compounds formed by the exchange. Thus, water extracted as a result of the planned operations should contain far less than the 7 gpl Pu minimum for criticality in a water moderated system. The routine radiation monitoring of such water for samples or for other extractions should readily indicate actinide concentrations which could present a safety hazard.

The primary criticality safety concern is Pu bearing material in solid form. Critical configurations of contaminated soil might result from the operations, such as redistribution of top crib layers by plowing actions or excavations. Although the above arguments indicate the Pu densities and masses are probably too low for criticality, the uncertainties in these Pu concentrations and distributions warrants extra precautions It does not appear that significant rearrangement of the soil layers would be needed as part of the workplans, wherein vacuum processing is carried out on existing wells. However, the plans for developing new wells or any procedures which involve redistribution of crib soil, cobble or sand contents should be reviewed by CEA before they are implemented.

In addition, the project procedures should require that any soil accumulations obtained from samples, excavations and/or drillings is to be treated as TRU solid waste, with the commensurate requirements for assaying, packaging and handling.

A secondary concern, considering the possibility that some soil regions could have Pu concentrations in excess of 3.5 g/l, is the potential for increasing reactivity due to process water penetrating into the fissile zones. Therefore, it will be necessary to prohibit water additions which could soak sufficiently deep, or which in streams could rearrange soil material.

4. REVISED CRITICALITY PREVENTION SPECIFICATIONS

On the basis of the foregoing discussions, revisions to the CPS for the deactivated cribs are authorized to;

a) include trench 216-Z-9 in the list of areas covered by the CPS

b) include the proposed carbon-tetrachloride extraction project in the list of allowed activities under the LIMITS section.

Under the current format for CPS's, the following should be included under the heading CONTROLS FOR CRITICALITY SAFETY;

1. Work plans and procedures for the above listed operations shall be reviewed and approved by the Manager, HWVP & Environmental Safety Assurance.

2. Addition of amounts of water for sampling, drilling, concrete penetration, or as needed in other operations shall be reviewed and approved by the Manager, HWVP & Environmental Safety Assurance.

3. Soil extracted from the crib areas as a result of the above operations shall be considered TRU solid waste, with the associated requirements for assaying, packaging and handling.

5. REVIEWER'S COMMENTS

Comments by the CEA internal reviewer have been incorporated into the report. In particular, the requirements for control over water additions was recommended.

6. REFERENCES

1) WHC-SD-EN-AP-046, Rev. 0, "200 West Area Carbon- Tetrachloride Interim Response Action Project Plan", WHC, January 9, 1991

2) WHC-SD-SQA-CSA-20240: CSAR 80-024; "Deactivated Cribs and Settling Tanks", S.J. Altschuler, Nov. 15, 1980 (SD release 1/19/90).

3) WHC-SD-SQA-CSA-20241: CSAR 80-024, Addendum 1; "Deactivated Cribs and Settling Tanks", R.D. Carter, January 21, 1988 (SD release 1/19/90).

4) SD-SA-CSA-20100: CSAR 80-024, Addendum 2; "Change Number of CPS for Deactivated Cribs and Settling Tanks", June 21, 1988.

5) SD-SA-CSA-20099: CSAR 80-024, Addendum 3; "Sampling of 216-Z-12 Vitrified Volume", R.D. Carter, June 21, 1988.

6) CSAR 80-004, "216-Z-9 Facility", L.E. Thomas, February 27, 1980.

7) ARH-600, "Criticality Handbook, Volume II", graph No. III.A.10(97)-6.

8) RHO-ST-21, "Report on Plutonium Mining Activities at 216-Z-9 Enclosed Trench", J.D. Ludowise, Sept. 1978.

WESTINGHOUSE HANFORD COMPANY	CRITICALITY PREVENTION SPECIFICATION
ISSUED BY: Manager Criticality Engineering Analysis	TITLE: DEACTIVATED CRIBS AND SETTLING TANKS

APPLICABLE LOCATIONS

This specification applies to the following deactivated cribs and settling tanks which serviced Z-Plant facilities at one time.

216-Z1	216-Z-2	216-Z-7	216-Z-12	216-Z-361
216-Z-1A	216-Z-3	216-Z-8	216-Z-18	

INTRODUCTION

In the past, radioactive wastes generated by Z-Plant processing have been routed to cribs and settling tanks. Since this is no longer the practice with the advent of routing wastes to the 242-T evaporator, the cribs and tanks used in the past have now been deactivated, but many contain significant amounts of plutonium. The purpose of this specification is to identify and limit what activities can be performed in these cribs and tanks without an additional criticality prevention specification.

LIMITS

The above cribs and tanks shall not be disturbed except the following operations are allowed:

1. Neutron poison addition
2. Sampling
3. Neutron Pulsing
4. Photographing
5. Installation of radiation monitoring and survey equipment.
6. Addition of amounts of water needed for sampling or concrete penetration operations if permitted, following review, by the Manager, Nuclear Facilities Safety.
7. Neutron activation studies.

None of the above operations shall be conducted in Tank 241-Z-361 without a prior procedure review by the Manager, Nuclear Facilities Safety.

FIRE FIGHTING

With the exception of the 216-Z-1 and 216-Z-2 (both wooden structures), nothing inside the cribs and tanks can burn; however, they do at times have structures above them that can burn. Water must not be added directly into a crib or tank (except Z-1 and Z-2 which have a low plutonium content), but can be used to fight a fire in structures and equipment located directly above a crib or tank. Care must be taken to minimize the amount of water allowed to drain into the cribs or tanks.

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APPENDIX B

CALCULATIONS FOR CARBON-TETRACHLORIDE PROJECT

I. MASS EQUIVALENCE OF SOIL PLUTONIUM RADIOACTIVITY

a) Quoted maximum Pu contamination is 4×10^4 nanocuries per gram (of soil):

b) Assume that the soil average specific gravity is 1.75 (as used by WA Blyckert in EBR-II cask calculations), for a mass of 1750 grams soil per liter.

c) Thus, the maximum activity per liter is

$$4 \times 10^{+4} \times 10^{-9} \times 1.750^{+3} = 7 \times 10^{-2} \text{ Ci per liter.}$$

d) The specific activities of the Pu isotopes are .0613 Ci/g ^{239}Pu and .22632 Ci/g ^{240}Pu. Assuming that the Pu is at least 5% ^{240}Pu, the average activity is 0.0713 Ci/g Pu.

e) This gives the plutonium concentration of

$$[7 \times 10^{-2} \text{ Ci/liter}]/ [0.0713 \text{ Ci/g Pu}] = 98.2 \times 10^{-2} \text{ g Pu/liter}$$

$$= 0.98 \text{ g Pu/l.}$$

II. MINIMUM CRITICAL MASS FOR 1.0 G/L PU CONCENTRATION

For dry sand (^{239}Pu plus SiO_2), at 1.0 g Pu/liter, the material buckling (Bm^2) was calculated by SJA to be 0.44016×10^{-4} cm^{-2}.

Conservatively assigning a reflector savings of 10 cm gives the following equation for the radius of a critical sphere at this density;

$$Bm^2 = [pi/(r + 10)cm]^2 = 0.44016 \times 10^{-4} \text{ cm}^{-2}$$

$$pi/(r + 10)cm = [0.44016 \times 10^{-4} \text{ cm}^{-2}]^{1/2} = 0.6634 \times 10^{-2} \text{ cm}^{-1}$$

$$\text{thus} \quad (r + 10)cm = [pi/0.6634] \times 100cm. = 473.53cm.,$$

giving a critical radius of 463.5 cm (which amounts to a 30-foot diameter sphere).

The volume of such a sphere is $(463.53)^3 \times 4/3 \times pi = 417170150$ cm^3,

= 417,170 liters. The critical mass would thus be 417 kg ^{239}Pu.

III. CRITICAL MASS FOR 10 G/L PU CONCENTRATION IN WET SOIL

For 30 vol.% Pu-water in soil as represented in ARH-600, at 10 g Pu/liter, the material buckling (Bm^2) is about 0.004 cm^{-2}.

The corresponding reflector savings of 9.0 cm (for full water reflection) gives the following equation for the radius of a critical sphere at this density;

$$Bm^2 = [pi/(r + 9)cm]^2 = 0.40 \times 10^{-2}\ cm^{-2}$$

$$pi/(r + 9)cm = [\ 0.40 \times 10^{-2}\ cm^{-2}\ ]^{1/2} = 0.6324 \times 10^{-1}\ cm^{-1}$$

$$\text{thus} \quad (r + 9)cm = [\ pi/0.6324\ ] \times 10cm. = 49.68cm.,$$

giving a critical radius of 40.68 cm (which amounts to a 32-inch diameter sphere).

The volume of such a sphere is $(40.68)^3 \times 4/3 \times pi = 281{,}936\ cm^3$,

= 282 liters. The critical mass would thus be 2820 g ^{239}Pu.

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ATTACHMENT 6

TOXICOLOGICAL CONSEQUENCES FOR RESTORATION AND REMEDIATION PROJECTS HAZARDS ASSESSMENT/200 WEST AREA CARBON TETRACHLORIDE PLUME

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Westinghouse
Hanford Company

Internal
Memo

From: Safety Hazards Analysis CCH-29240-91-002
Phone: 6-3189 N1-37
Date: March 14, 1991
Subject: TOXICOLOGICAL CONSEQUENCES FOR RESTORATION AND REMEDIATION PROJECT HAZARDS ASSESSMENT/200 W AREA CARBON TETRACHLORIDE PLUME

To: R. R. Lehrschall B1-35

cc: E. E. Leitz EEL N1-37
L. D. Muhlestein N1-28
D. R. Ellingson B1-35
CCH File/LB

References: (1) C.H. Huang, 1979: A Theory of Dispersion In Turbulent Shear Flow, Atmospheric Environment Vol. 13, pp 453-463.

(2) Drake, R.L., D.L. McNaughton and C.H. Huang, 1979: Mathematical Models for Atmospheric Pollutants Available Air Quality Models, EPRI EA-1131.

(3) Glantz C.S., M.N. Schwartz, K.W. Burk, R.B. Kasper, M.W. Ligotke, and P.J. Perrault, 1990: Climatological Summary of Wind and Temperature Data for the Hanford Meteorology Monitoring Network. PNL- 7471, UC-603, Pacific Northwest Laboratory, Richland WA 99352.

An evaluation was performed, upon request of the Restoration Safety Documentation organization, to estimate the effect of meteorological conditions on the toxicological consequences, resulting from postulated scenarios associated with the subject project.

The release of carbon tetrachloride from a heated carbon adsorption unit was investigated. The accident scenario assumed that the carbon filter is heated by an accidental fire, and the CCL4 desorbed over a 30 minute period. Environmental factors strongly influence the severity of the consequences. A change of meteorological conditions can affect the concentration at a downwind location. The toxicological concentration calculated from a Gaussian plume model (WHAZAN, 1988; C.H. Huang, 1979; and R.L. Drake, D.L. McNaughton and C.H. Huang., 1979) at a downwind location is inversely proportional to the wind speed; assuming the same atmospheric condition. The dilution factor used to calculate downwind plume concentration increases with increasing wind speed. Doubling the wind speed would reduce the concentration by one half. The probability of occurrences for a wind speed less than 4 m/s with the atmospheric stability classes F and G estimated from the meteorological wind data (C.S. Glantz, et al., 1990) is about 18 %; corresponding to 80 percentile concentration

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R. R. Lehrschall
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level. Therefore, the 50 percentile concentration level used for the estimates of concentrations is a conservative assumption in this case.

The analytical solution of a Gaussian plume model as well as climatological wind and temperature data were used to extrapolate the concentrations obtained from WHAZAN computer code to other meteorological conditions. The calculated results of concentrations from a continuous plume with a period of thirty minutes are shown in Table 1 for a wind speed of 2 m/s as compared to that in Table 2 for a wind speed of 4 m/s for the same emission rate and the atmospheric stability class F. The calculated concentrations from a continuous plume for the release periods of thirty minutes and two hours at 50 percentile meteorological data or concentration level are shown in Tables 2 and 3. The results of the re-calculations by using WHAZAN computer code (see attachment) confirm the extrapolated results which were obtained from the use of the analytical solution of a Gaussian plume model. Since the ground-level release is assumed in the calculations, the calculated results are conservative (see attached Note).

Chester Huang
C. H. Huang, Principal Engineer
Safety Hazards Analysis

siw

Attachments

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ATTACHMENT

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<u>NOTE</u>

The WHAZAN dispersion calculations were done using a ground-level release. Since the carbon tetrachloride is released from the carbon adsorption unit by virtue of heat supplied from an accidental fire, the heat would result in supplying plume buoyancy and would make the release behave as though it were an elevated source. This would decrease ground-level concentrations to below those calculated here.

Table 1
Toxicological Concentrations During An Accident
Continuous Release Plume
(30 minutes, 2 meters/second)

Hazard Source	Resultant Exposure			Limit	
	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA
Carbon Tetrachloride					
235 lb/day	1.5 ppm	0.01 ppm	0.002 ppm	300 ppm	5 ppm
300 lb	92.5 ppm	0.43 ppm	0.13 ppm	300 ppm	5 ppm
600 lb	185 ppm	0.85 ppm	0.25 ppm	300 ppm	5 ppm
1200 lb	370 ppm	1.70 ppm	0.50 ppm	300 ppm	5 ppm
1800 lb	555 ppm	2.55 ppm	0.75 ppm	300 ppm	5 ppm
2400 lb	740 ppm	3.40 ppm	1.00 ppm	300 ppm	5 ppm
Phosgene					
	0.27 ppm	< 0.1 ppm	< 0.1 ppm	2 ppm	0.1 ppm

Table 2
Toxicological Concentrations During An Accident
Continuous Release Plume
(30 minutes, 4 meters/second, 50% meteorology)

Hazard Source	Resultant Exposure			Limit	
	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA
Carbon Tetrachloride					
300 lb	46.3 ppm	0.22 ppm	0.07 ppm	300 ppm	5 ppm
600 lb	92.5 ppm	0.43 ppm	0.13 ppm	300 ppm	5 ppm
1200 lb	185 ppm	0.85 ppm	0.25 ppm	300 ppm	5 ppm
1800 lb	278 ppm	1.28 ppm	0.38 ppm	300 ppm	5 ppm
2400 lb	370 ppm	1.70 ppm	0.50 ppm	300 ppm	5 ppm
Phosgene					
	0.13 ppm	< 0.05 ppm	< 0.05 ppm	2 ppm	0.1 ppm

Table 3
Toxicological Concentrations During An Accident
Continuous Plume With A Two Hours Release
(4 meters/second, 50% meteorology)

Hazard Source　　Resultant Exposure　　Limit

	Onsite 150 m	Offsite 4.5 km	Nearest Resident 12.4 km	IDLH	TWA
Carbon Tetrachloride					
300 lb	11.6 ppm	0.06 ppm	0.02 ppm	300 ppm	5 ppm
600 lb	23.1 ppm	0.11 ppm	0.03 ppm	300 ppm	5 ppm
1200 lb	46.3 ppm	0.21 ppm	0.06 ppm	300 ppm	5 ppm
1800 lb	69.5 ppm	0.32 ppm	0.10 ppm	300 ppm	5 ppm
2400 lb	92.5 ppm	0.43 ppm	0.13 ppm	300 ppm	5 ppm
Phosgene					
	0.03 ppm	< 0.01 ppm	< 0.01 ppm	2 ppm	0.1 ppm

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